THE INTELLECTUAL OBSERVER.

OCTOBER, 1866.

PRISMATIC SPECTRA OF THE AUGUST METEORS, 1866.

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(With Coloured Plate.)

An instrument for observing meteors was described in the August number of this journal, which had for its—certainly very unique, if not indeed for what must have appeared its impossible—object, to examine the colours, or other peculiarities of the prismatic spectrum produced by a ray of light emitted from the luminous streak, or from the nucleus of a shooting-star. A wide field of view; great facility of direction,—or in other words direct vision; the means of pressing two quick eyes into the service,— or, in other words, binocular arrangement; and, last of all, great power in the prisms, are the characters without which an instrument for viewing meteor spectra will be comparatively useless. A peculiar construction of prisms, described in a former volume, and a binocular arrangement of the same prisms, figured in the last-mentioned number of this journal, and answering all the above conditions, was invented as early as the year 1864 by the writer of these pages; and a meteor spectroscope, of the pattern now made by Mr. Browning, was presented by the writer to Mr. Babinet, at Paris, in August, 1864; without any attempt having hitherto been made, so far as the writer has been able to learn, to examine the peculiarities of meteor spectra, either by this or by any other means. If the problem of chemically analysing the substance of luminous meteors, by means of their light spectra, is not yet fairly solved, it is at all events pretty certain, from the following observations, that the metal *sodium* produces the most enduring light of the much-admired trains of the August meteors; and that at least one other mineral substance (either potassium, sulphur, or phosphorus) lends its aid, but in a much less remarkable degree, to produce the same luminous trains. Observations renewed

on the 13th of November will, doubtless, show a different result. The streaks of the November meteors are quite as enduring as those left by meteors on the 10th of August; but their colour is white, verging to blue, while a glance at the brightest and most enduring meteor-streaks left on the 10th of August generally shows their *yellow* cast of colour. The first, or rudimentary colour of the August meteor-streaks is, like that of the November streaks, white or bluish; and some few continue of this colour until they disappear. The effect is owing to the ignited vapour of the other mineral substance (potassium, sulphur, or phosphorus) to which allusion was just made, playing a principal part in the production of the streaks. Although glowing for a much shorter time, and with less intensity than the vapour of the metal sodium, it nevertheless in some instances forms the entire light of the meteor-streaks seen on the 10th of August. White, bluish, or "phosphorescent" streaks are most prevalent among the November meteors, and the light of this element, whatever it be, by which this bluish kind of phosphorescence of the streaks is produced, will probably appear more highly developed, and its spectrum will be more easily identified in the streaks of the meteors on the 13th of November, than it could be (from the brightness of the sodium-line) in the enduring streaks of the meteors of the 10th of August last. It extends between the red and the blue; and is that portion of the visible train-spectrum which is called "diffuse" in the following observations:—

The meteor spectroscope, as already described, presents to the view a pretty considerable extent of the star-spangled surface of the sky. The spectra of the well-known "seven stars" of Ursa Major, may, for example, be seen together in the instrument at a glance. Each bright star is converted into a line of highly-coloured light, nearly three-quarters of a degree in length; and horizontal, when the instrument is held in its natural position. Fifth magnitude stars are obliterated, and fourth magnitude stars appear only as a greyish line of light of no decided tint or colour. Prismatic hues are first perceptible in stars of the third magnitude and upwards. When the spectroscope is turned to a given part of the sky, the stars, through it, appear as if a gigantic wet brush had been applied to them in that part of the sky, and their light had been partially washed out in a particular direction. The effect is produced by the dispersion of the light of each star in passing through the prisms. Its single beam is spread out, as it were, into a fan of different coloured rays, called its "prismatic spectrum," and its light is proportionately enfeebled; but the stars appear to occupy very nearly the same relative positions

in the field of view of the meteor spectroscope as that which they occupy in the sky to the unassisted eye. In this manner the instrument is well adapted for analysing the light of any bright object presenting itself for a moment in the part of the sky under examination, as, for example, the light of a shooting-star, or of its bright, fast-fading luminous train.

A flame of mono-chromatic light, or of light possessing only one degree of refrangibility presents, when viewed in the meteor spectroscope, a striking aspect. The flame of a common spirit-lamp, for example, possesses a faint and hardly distinguishable spectrum. Its light, when viewed through the instrument, is so dispersed, in a horizontal direction, as to be almost washed out, or obliterated; but if salt be introduced into the wick, the flame at once becomes conspicuous, and the homogenous character of its light is perceived by the sharpness of the definition, every flicker of its outline being visible, as perfectly and as brightly as it appears to the naked eye. The example of the spirit-lamp with a salted wick illustrates the streaks of some of the August meteors, which, when examined optically by the meteor spectroscope, reveal their chemical character from the composition of their light. Seventeen spectra were observed, in eight of which the sodium line, for the most part brilliant, and in some cases forming the entire spectrum of the streak, was plainly visible. Its position relatively to the rest of the spectrum, "on the side towards the red" (Nos. 9, 12, and 14), its golden yellow colour (Nos. 7, 8, 12, 14), its extreme brightness (Nos. 7, 14), and its single or isolated appearance (Nos. 8, 14) perfectly agree with the well-known appearance in the spectroscope of the yellow sodium flame; and at the same time with the spectrum of no other elementary substance, sodium only excepted, with which the spectroscope has made us acquainted. That the element sodium should be the first detected in the meteor spectra is by no means surprising, when the well-known brightness of this line of the spectrum is considered, wherever a trace of sodium exists in the outer luminous envelope of a flame. Nevertheless the fact, that the sodium line has been observed in the spectrum of lightning, is no proof that the meteor-streaks owe its presence in their light to the existence of the vapour of sodium in the atmosphere. No lines of nitrogen, or of any other known gas, accompany the sodium flame in the train spectra of the August meteors; but on the other hand the great intensity of the sodium streaks makes it almost certain that the meteors contain this element as a part and parcel of their chemical composition.

To obtain the spectra of meteors, a night must be chosen when they are more than ordinarily plentiful (such as, for

example, the 10th of August, or the 13th of November), and the attention should be directed below the radiant point, to that portion of the sky where the meteors will, in all probability, appear to fall vertically towards the earth. Near (*but not too near*) the radiant point, their course is also foreshortened, and their apparent motion is comparatively slow. Their course in the spectroscope will in this case appear parallel to the refracting edges of the prisms, which is an essential point to be kept in view in the arrangement of the spectroscope, so as to obtain the prismatic spectra of meteors. Some resolution, in the next place, is required to fix the attention constantly within the stipulated bounds; for the sky meanwhile is alive with meteors; and some few are of a startling kind, perhaps even calculated to shake the nerves of any but a cool observer. Paying attention to these precautions during the hours from midnight until sunrise on the morning of the 13th of November next, no difficulty, it is apprehended, of any kind will be experienced in obtaining the spectrum of a shooting-star; and as the necessity of the case seems to require it, notes should be made of their most peculiar features.

All the necessary preparations having been made, and with the prospect of a considerable meteoric shower at hand, a watch for meteors was commenced, in order to observe their spectra, on the night of the 9-10th of August last. Expectation on the first night was not destined to be disappointed, and six meteors were observed to pass across the field of view. Notes of the peculiarities were made, and of the general appearance of their spectra, and are briefly as follows:—

August 9th.—No. 1; 8h. 40m. p.m. About equal to a fourth mag. star. Passed across the body of Cygnus, in half a second; leaving no streak. The spectrum exactly resembled that of a fourth mag. star (o Cygni) close to which the meteor passed, the conclusion being that *the meteor might be a solid body, heated to ignition.*

August 10th.—No. 2; 0h. 27m. a.m. Nearly as bright as Sirius. Commenced near Polaris (in the field of view), and shot 15° or 20° (beyond the field of view) along a line directed from Cassiopeiæ, leaving a streak on its whole course for four seconds. The latter part of the meteor's course was seen with the naked eye. In the spectroscope two images of the meteor and of the streak were visible, one refracted, and one accidentally reflected at the side. These two images of the meteor and of its streak could not be distinguished apart, at least in their general appearance, the conclusion being that the light both of the nucleus and of its luminous streak was homogeneous, and that *its luminous substance was a gas.*

No. 3; 0h. 42m. a.m. A very brilliant fire-ball, with a flash

like lightning, burst overhead, leaving a streak from θ Cygni, half-way to α Lyra, for twenty seconds. A cloud unfortunately dimmed the streak. In the spectroscope, as far as cloud would permit any judgment of the streak to be formed, its aspect was the same as to the unassisted eye. The light of the streak was therefore probably homogeneous, and *the streak itself probably a luminous gas.*

No. 4; 1h. 15m. a.m. About equal to a second mag. star. Shot in three-quarters of a second, from θ Cassiopeiæ half-way to o Honorum, and then turned round the quarter of a circle, to u Honorum, where it vanished, leaving a streak for half a second on its course. In the spectroscope the general appearance of the meteor, and of the streak in the field of view, was the same as that of the purely reflected image by the side; the conclusion being, as before, that the light, both of the meteor and of the streak, was homogeneous, or that *the luminous substance of the meteor was a gas.*

No. 5; 1h. 40m. a.m. About equal to a second mag. star. Passed slowly through a short path near β Tauri, directed from Cassiopeiæ; duration, one second; leaving a streak at the place for three seconds. The spectrum of the meteor and streak was quite equally diffused over a space about $\frac{1}{4}^{\circ}$ in width; its colour greyish white; the diffuse train-spectrum vanished without further change, the conclusion being that in this case *the train might, like the nucleus, be composed of heated sparks.*

No. 6; 2h. 15m. a.m. Equal to a first mag. star. Shot on the same course as No. 2; duration, one second; leaving a bright streak for four seconds. The spectroscope was turned towards the streak before it disappeared. The train was widened by the prisms to a greyish-white band, somewhat greater than a quarter of a degree in breadth. It faded from sight without further change; the conclusion in this case also being, that *the train might possibly be composed of heated sparks.*

Three spectra in the foregoing observations appeared homogeneous, like that of a luminous gas (Nos. 2, 3, 4); and three were continuous, or diffuse (Nos. 1, 5, 6), like that of an ordinary spark. The question, accordingly, whether luminous meteors might or might not contain solid substance, remained undecided, when daylight beginning to appear, put a stop to further observations.

The following night, observations could fortunately be resumed, and the perplexing appearance of the meteor spectra on the previous night, received a truly surprising and most satisfactory explanation, in the repeated appearance in the spectra of the streaks of a yellow line, *unmistakably that of the metal sodium in combustion.*

Two observers being engaged to watch on this night, one checked the observations of the other with the naked eye. The troublesome reflected image in the spectroscope could accordingly be dispensed with, and it was kept out of sight; so that the views obtained of the meteor spectra came as nearly to perfection as could be wished.

August 10th, continued.—No. 7; 4h. 22m. p.m. Equal to a first mag. star. Shot from γ Cephei to l Draconis in three-quarters of a second; leaving a bright streak for five seconds on its course. The meteor first appeared in the field of view, and passed out of it. The brightest portion of the streak, however, was brought into the middle of the field of view; where it occupied an excellent position, parallel to the refracting edges of the prisms, for viewing its prismatic spectrum. A slight effect of distortion (produced in the prisms) caused it to appear bent, like a bow, across the field of view (Fig. 7). The spectrum presented the appearance of a narrow line of light, exceedingly brilliant, of a golden-yellow colour, and not more than 5′ in width. It faded gradually along its whole length, and disappeared in about two and a half or three seconds. Its description, noted in the register, kept for the purpose at the time, was—"neither double, triple, nor multiple, nor continuous, *but purely and positively mono-chromatic.*"

August 11th.—No. 8; 0h. 15m. a.m. Equal to a third mag. star. Shot from β Cephei to δ Draconis, in three-quarters of a second; leaving a luminous streak for two seconds. The spectrum of the streak was a remarkably slender, orange-yellow line of no appreciable breadth, without any continuous spectrum near to it, or any other neighbouring bands, or lines. It was very bright, remaining in sight two seconds; and it gradually faded away until it vanished. The spectrum of the nucleus appeared to be undistinguishably the same as that of the streak.

No. 9; 0h. 20m. a.m. Equal to a third mag. star. Shot from *a* Cephei to 33 Cygni (Fl.), in three-quarters of a second; leaving a streak for one second and a half. The spectrum of the streak was dull grey, diffuse, about $\frac{1}{4}^\circ$ in width, with a yellow line included in it, *on the side towards the red.* The yellow line and the diffuse band disappeared together. The spectrum of the nucleus, appeared to be appreciably the same as that of the streak.

No. 10; 0h. 33m. a.m. Equal to a fourth mag. star. Shot from ρ Cassiopeiæ to *o* Honorum, in half a second; leaving no streak. The spectrum of the nucleus appeared to be concentrated into a few faint lines with wide intervals between them, but this description is very uncertain.

No. 11; 0h. 33m. a.m. Equal to a third mag. star. Re-

turned about half way along the course of the preceding meteor, in half a second; leaving no streak. The spectrum of the nucleus was a concentrated point of yellow light, having all the appearance of some yellow shooting-star.

No. 12; 0h. 42m. a.m. Equal to Sirius; colour white. Shot from *a* Trianguli to *η* Piscium, in one second and a quarter; leaving a streak for four seconds on its course. In the spectroscope the meteor slowly crossed the middle of the field of view, on a course directly parallel to the refracting edges of the prisms, producing a very superb spectrum. The spectrum of the nucleus was red, green, and blue; extremely brilliant. The train-spectrum was diffuse; ¼° in width; in which a thin bright orange-yellow line was plainly seen *on the side towards the red*. The diffuse portion of the train-spectrum faded in about two seconds, apparently following the nucleus. The sodium-line remained extremely bright for not less than two seconds longer, and faded gradually along its whole length, when it also disappeared. The singular characters of this spectrum were most distinctly and beautifully seen, and the long endurance of the sodium line, after the rest had disappeared, was leisurely watched.

No. 13; 1h. 23m. a.m. Equal to a third mag. star. Shot from P Camelopardi to *a* Draconis in half a second; leaving a streak for two seconds on its course. The train-spectrum was a diffuse band of greyish light, ¼° wide, somewhat brighter on the side towards the red, and it so vanished.—The spectrum of the nucleus was appreciably the same as that of the streak.

No. 14; 1h. 55m. a.m. Equal to a first mag. star. Shot from *o* Custodis to 3° below Polaris, in three-quarters of a second; leaving a bright streak for three seconds. The meteor first appeared in the field of view, and passed out of it. The spectrum of the early portion of the streak, behind the nucleus, was a greyish diffuse band, ¼° in width. The spectrum of the nucleus was appreciably the same. The brightest part of the streak, before it faded, was brought into the field of view, well situated parallel to the edges of the prisms, and in the middle of the field for about two seconds. Its appearance was that of a golden-yellow line of light, about 5° in length, some 4′ in width, tapering gently towards the ends; and perfectly sharp and well defined. It was unaccompanied by any continuous spectrum, or any bands, or other lines; and it so disappeared from the ends towards the centre.

No. 15; 2h. 15m. a.m. Equal to a second mag. star. Shot from *μ* to *a* Andromedæ in three-quarters of a second; leaving a streak for two seconds. The train-spectrum was a diffuse, greyish-white band; ¼° in width, and about 6° or 7°

long; and faded away without any further change. The spectrum of the nucleus showed prismatic colours.

No. 16; 2h. 16m. a.m. Equal to a second mag. star. Shot from θ Cassiopeiæ to β Andromedæ, in half a second, leaving a streak for two seconds and a half. The meteor was seen with the unassisted eye. The last-fading portion of the streak was examined in the spectroscope, where it appeared more widely diffused than when seen with the naked eye. Its colour in the spectroscope was a dull greyish white.

No. 17; 2h. 27m. a.m. Brighter than a first mag. star. Shot from *a* Cassiopeiæ to *o* Honorum, leaving a streak for two seconds and a half. The train-spectrum was a diffuse greyish-white band, $\frac{1}{4}^{\circ}$ in width, not sensibly brighter in any part; and it so faded. The spectrum of the nucleus was bright,—red, and green.

Daylight at this time began to appear, and observations were obliged to be discontinued; the streaks of the August meteors might, however, already be plainly divided into two classes. In the majority of cases, a bright yellow line, having the unmistakable appearance of the sodium line, was clearly visible in the spectrum. In a smaller number of cases the spectrum was merely a diffuse and greyish light band, or ordinary spectrum of weak intensity, resembling the spectrum of the glowworm's light. It will be interesting to observe this form of meteoric spectrum, should it be more common among the "phosphorescent" streaks of the November meteors than it was in August last; when only five such purely "phosphorescent" streaks were noticed, entirely free from sodium light.

The spectra of the meteor-nuclei were seen in a few cases only with distinctness; as they were in general overpowered by the brightness of the sodium light, whenever that was present. When the streaks were phosphorescent only, and free from sodium light, the nuclei in general presented highly-coloured spectra, like the spectrum of solid matter at a glowing white heat, or like the spectrum of an ordinary gas flame containing white-hot solid particles of carbon. A better night for observing nucleus-spectra would be the 12th of December, when meteors leaving no trains are plentiful; and they are for the most part very brilliant, radiating from some part of the constellation Gemini.

That which spectral examination of the August meteors has most certainly brought to light, is the existence of an extraordinary quantity of the vapour of sodium in their luminous streaks; so that many of the streaks, especially the most conspicuous, and the most slowly-fading amongst them, consist of nothing else but soda flames for a great propor-

tion (that is to say the latter portion) of the time that they continue visible. Their condition is then exactly that of a flame of gas in a Bunsen's burner, freely charged with the vapour of burning sodium; or of the flame of a spirit-lamp newly trimmed, and largely dosed with a supply of moistened salt.

It is difficult to believe that the vapour of the metal sodium exists, in such considerable quantities, at the confines of the atmosphere. It is much more reasonable to suppose that it is brought into the atmosphere by the meteors themselves, so as to be deposited in the luminous trains that mark their course. The material of the August meteors is, therefore, probably a mineral substance, in which sodium is one of the chemical ingredients. Such is the rather satisfactory termination of an experiment, which it will be very easy to repeat, whenever an abundance of meteors on the night of the 10th of August offers an equally favourable opportunity for examining their spectra by the aid of the meteor spectroscope.

The connection believed by adherents of Chladni to exist between shooting-stars and aërolites is now shown, at least in August, to extend itself in some measure to their chemical composition. The meteorites of Aumale, which fell on the 25th of August, 1865, were found, on analysis by Mr. Daubrée, to contain *soluble salts* (chloride and carbonate) of sodium. A circumstance so uncommon in the composition of aërolites, allies the meteorites of Aumale very closely with the sodium-bearing streaks of the meteors of the 10th of August.

In this manner each new acquisition of knowledge, however unforeseen may be its origin, tends to support the theory of Chladni, and to confirm the belief that shower-meteors and shooting-stars are actually aërolites of small dimensions. In whatever manner aërolites and shooting-stars are related to each other in their astronomical and other peculiarities, they will certainly require a vast number of further experiments to unfold their real source.

EXPLANATION OF THE PLATE.

The meteor spectra are numbered in the plate, after the description in the text, in the order of their appearance; *a*, represents the spectra of the nucleus, and *b*, the spectra of the meteor trains. Double white lines indicate the boundaries of the field of view.

Figs. 1, 10, represent the persistent luminous impressions of the *nucleus* only, and the meteors left no streak. 1, a meteor in *Cygnus*; 10, a meteor spectrum, conveying a faint

impression of interruptions; 11, the meteor could be followed by the eye, but it left no streak.

Figs. 2, 4, refracted and reflected images, viewed together (A refracted, B reflected), of *Polaris* (*a*); and of two meteors.

Figs. 5, 6, 13, 15, 16, 17, diffuse train-spectra.

Figs. 9, 12, ditto containing the *sodium line*.

Figs. 7, 8, 11, 14, purely mono-chromatic, or *sodium* meteor spectra; similar to Nos. 2, 4, but better defined.

Fig. 12, *bis.*, represents the appearance of No. 12, two seconds after the disappearance of the meteor. Total duration of the streak, four seconds.

Note.—The distortion or curvature of the streak by the prisms, was plainly seen in No. 7, but not in the remaining spectra. The meteor spectroscope was generally held nearly horizontally; but in No. 12 the instrument was held almost vertically, and the meteor moved in a nearly horizontal direction. The effect of producing the prismatic spectrum was the same as in the other cases.

THE LINEATED PHEASANT OF BURMAH.

BY CAPTAIN R. C. BEAVAN.

Synonyms. *Gallophasis lineatus*, Auct. Jerdon's *Birds of India*, vol. ii., part 2, pp. 531 and 535. *Euplocomus lineatus*, Belanger, who has figured it in his voyage, plate 8 of Birds. *Phasianus lineatus*, Latham. *Phasianus reynandii*. Lesson. Genus, *Grammatoptilus*, of Reichenbach. Mason's *Burmah*, edit. 1860, pp. 230 and 687. Burmese name "Yeet" or "Yit."

Dr. Jerdon, in his famous work, the *Birds of India*, describes the group of the Kallege Pheasants, amongst which he includes the species under review, as one which leads from the true pheasants (of which *Phasianus colchicus*, Linn., the Common Pheasant of the British Islands, is a type) to the Firebacked Pheasants and Jungle Fowl of India and Malayana; and as the group in question partakes of the characters of both the true pheasants and the jungle fowl, so in its geographical distribution it is found to range from the Himalayas, the head quarters of the pheasants, to the Burmese provinces, where jungle fowl and their allies take their place.

The genus *Gallophasis*, of Hodgson, or that of the Kallege Pheasants, as they are more popularly termed, embraces at least four species—two from the Himalayas—a third from Assam and Arracan, and the fourth, our species, from the

Tennasserim provinces of Burmah. They are birds about the size of a fowl, with glossy black and white plumage in the males, the females being invariably of a sober brown hue; the fleshy orbits, or naked skin round the eyes, is bright red in both sexes, and both have a well-developed crest. The tail is moderately long, of sixteen feathers, raised in the centre as in the domestic fowl, and held demi-erect, the feathers drooping and curving outwards. Essentially hill birds, they live at various elevations of from 1500 to 7000 feet above the level of the sea, and in places where they occur abundantly, are for the most part the only species of pheasant found, at the comparatively low elevations frequented by them.

The male of the species under notice has the colouration of the neck, back, and upper parts generally, almost exactly similar to that of the domestic guinea-fowl. The two arched central tail feathers are of a pearly grey white, much more so than the rest: the throat, breast, and underparts are black, with the sides of the throat and flanks longitudinally striated with white. The head is pure black, with a long pendent crest; the orbital skin bright red, beak greenish, horny, legs duller and strongly spurred. Length, about 27 to 28 inches, and weight about 3 lbs. The female is a smaller bird, of a light brown colour throughout, without a trace of black; the orbital skin as in the male, but she has no spurs, and the crest is smaller. The irides are reddish brown in both sexes.

In 1865, when the last list of vertebrated animals, living in the gardens of the Zoological Society of London, was published, there were two pairs of this species flourishing there, besides hybrids, and in the same year I brought up two fine males with me from Burmah, which have since been forwarded, and I hope ere this been safely received by the Society.

Whilst in Burmah, I had several opportunities of seeing this handsome bird in a state of nature, and as hardly anything regarding its habits or economy has as yet been recorded, I proceed to give briefly in detail the results of my own observations, and of information procured on the spot from intelligent natives who were in the habit of capturing them, either for their own use, as food, or for sale in Moulmein.

They breed in the month of "Tagoo," that is, about the month of May, or beginning of June. The nest is always built on the ground, and the female lays from five to seven eggs of a brownish olive colour, like those of the English pheasant, but perhaps somewhat smaller; the young male is at first like the female in colour, but apparently begins to gain his proper plumage after the first moult, and has it perfected by the end of a year. The general habitat of the species may be defined as the thick bamboo and forest jungle, which

clothes the foot and lower slopes of all the hill ranges in the Tennasserim provinces of Burmah. The elevation above the sea cannot be great, but the vegetable productions of this tract of country agree well with those found at an elevation of about 2000 feet in the Himalayas.

Their food consists chiefly of white ants, but they also pick up the roots of plants, young shoots, and when ripe the *toungyar* paddy, or hill-grown rice. In the dry season they are found about the foot of the hills, wandering somewhat as water becomes scarce, but in the rains return to the hill-sides, from which I imagine they never at that time of year move far. In fact, judging from the habits of their congeners in the Himalayas, I should say they were inclined, unless compelled to move by necessity, to keep very much to the same spots on the particular hill-sides they most like. I have found the Sikkim kallege invariably returns to the same bough every night to roost, in spots where seldom disturbed.

The Burmese bird seems to be more gregarious than the Himalayan kalleges. My informant tells me he has seen as many as twenty to twenty-five together, but I should think that this was an unusual occurrence; four or five—perhaps a family of the previous year—would apparently be more usually met with.

Mr. Blyth, a well-known authority on such matters, mentions that some varieties of this bird are scarcely distinguishable from the Assam species of kallege, *Gallophasis Horsfieldi*, Gray, the probability being that where the two species meet in Arracan, individuals of hybrids will be found to occur, in every intermediate phase of plumage; since we know that such are common, where, as in Nepaul, the white-crested bird of Simla meets the black-crested one of Sikkim.

I was lucky enough, during a short stay at Thatone, a town in the Martaban district, some forty miles to the north-west of Moulmein, to see the way in which the Burmese capture the species.

A tame male bird, for which, if a good decoy, as large a sum as twenty-five rupees is sometimes given, is taken and pegged down to the ground in an open space, between three or four clumps of bamboos, on the hill-side frequented by the wild birds. The birdcatcher is led to the choice of a good spot by the recent signs of fresh droppings, or lately upturned soil. The tame bird has a range round his peg of a diameter of about four feet only. In a circle round him, at the distance of about six feet, a row of upright running nooses are fixed in a continuous line, while further off, at the distance of some ten or twelve yards, all likely openings between clumps of bamboos are guarded by other lines of nooses. Half an onion is

then administered to the call-bird, and his ire being aroused by shaking the hand near him, when the bird-catchers retire behind some bushes within thirty or forty yards, and there await the result. If a wild bird is within hearing of the tame bird, the latter will make a peculiar drumming sound with its wings. Jerdon mentions this noise as being also made by the male of the Simla kallege, *Gallophasis albocristatus*, Vigors, but was not aware of the cause which led to its production. "The male often makes a singular drumming noise with its wings, not unlike the sound produced by shaking in the air a stiff piece of cloth. It is heard only in the pairing season, but whether to attract the attention of the females, or in defiance of its fellows, I cannot say, as I have never seen the bird in the act, though often led to the spot where they were by the sound."*

Each wild male is apparently "cock of the walk" of a particular portion of jungle, and on hearing this insult offered to him in his own domain, quickly pushes for the spot, in order to inflict speedy punishment on the daring intruder. By following the direction of the looks of the tame bird, who gets much excited, the wild one is seen to approach quickly until within a short distance of his adversary, whose looks he measures with no friendly eye, as he marches round and round, with feathers puffed out, until he looks twice his usual size, and gives utterance at intervals to angry notes of defiance. Nearer and nearer he comes, and if he does not, in his eager haste, get noosed whilst approaching, terrific is the battle that ensues, and feathers fly in all directions. The wild bird gets so excited that he speedily becomes absorbed, so intent is he on killing his adversary, in which he would doubtless succeed, did not the hidden Burman, anxious for the safety of his pet, throw a stone, which, dropping into a bush, scares the wild bird, who runs off in a hurry through the nearest opening, and gets caught in a noose.

In case the decoy does not begin to drum of his own accord, the birdcatcher imitates the sound with some feathers tied on a stick, which he rapidly twirls between the palms of his hands, so as to cause a humming sound. The effect of this is increased by the voice, and the result is an exact resemblance to the humming sound produced by the quick vibration of the wings of the bird. The sound immediately sets off the decoy, or brings the wild bird to the spot.

The sport is carried on by two men—one carries the decoy about, carefully muffled up in a cloth until wanted; and the other takes charge of the bundle of nooses, and a dhar, or heavy Burmese knife, with which to clear away the brushwood. If

* *Birds of India*, vol. ii. part 2, p. 533.

after an interval of from ten minutes to a quarter of an hour no response is met with to the drumming of the decoy, the bird-catchers move off to try another spot. They are at times very successful, and catch three or four birds near one place, where plentiful. Of course, males are most frequently taken by this method; but females, also, turn up sometimes, and in paying a friendly visit to the decoy, get captured. They appear to be much more difficult to keep in confinement than the stronger sex.

The method of capture here described is practised in Burmah all the year round but with most success during the pairing season.

THE STREET ARCHITECTURE OF LONDON.

In our former article we feel strongly that due justice has not been done to Gwynn, for his *London and Westminster Improved*, in 1766; or to Mr. Haywood, for his admirable report made in the present year 1866; but we must not forget that we have undertaken to note down a few remarks upon the street architecture of our metropolis as now existing; in attempting which we have the advantage of the observations of a young Parisian architect, who has lately been consigned to us by letters of introduction, and to whom we felt it both our duty and pleasure to act as cicerone. It occurred to us that we could not better commence our duties than by taking our young friend Alphonse Fontaine to the summit of St. Paul's, for a bird's eye (*coup d'œil*) of our metropolis. There is always a great charm in a general view from an elevated position, and—*malgrè* the smoke from those abominable and reeking shafts in Lambeth—our friend was delighted with what he saw, and his first observation was, "What a charming effect from your atmosphere. With us on the Continent, everything is marked out clear, crude, and distinct; but here you have an atmospheric medium, which gives an effect to objects most agreeable and enchanting. It is what your celebrated Turner has obtained in his pictures—there is a medium between the spectator and the objects—an aerial effect, adding to the perspective and to the *chiaro oscuro* of the scene. But where are your domes beyond the one I am standing on? In the distance I see two gems at Greenwich; but those on what you term your National Gallery, your London University, and Bethlehem Hospital are mere *pimples*. In Paris we can boast of several noble domes, and hence the

magnificent appearance of our city when viewed from any of the environs."

We had no excuse to offer, and contented ourselves with the apologetic reply that formerly there was a charming cupola upon the church of St. Benet Fink, and another very picturesque dome close by us over the College of Physicians, both of them the works of Sir Christopher Wren, and both lately demolished. There were two others to the westward, which we had no little difficulty in explaining to him were called "the Brompton boilers," but which the good sense of Parliament ordered to be taken down.

The young French architect, seeing our chagrin on the paucity of domes, good naturedly replied, "Well, but you compensate for them in your spires and steeples. What charming forms are those of Bow, St. Bride's, St. Magnus, St. Vedast, St. Dunstan's in the East, and even that humble one close upon us, St. Martin, Ludgate!" and when we informed him that they were all the works of Sir Christopher Wren, he exclaimed, "He was, indeed, an architect!"

The interior of St. Paul's did not excite so much surprise or approval from our companion, beyond being astonished at the aerial effect of the dome, and its *apparent* over its *real* magnitude. Of the embellishments and decorations now in progress he was silent, although it was explained to him they were the works of *foreign* artists. A shrug only was expressive at this announcement. The exterior excited more of our friend's praises than the interior, and the picturesque towers at the west end of the Cathedral, and the circular porticos at the north and south sides he greatly commended.

Instead of adopting the usual plan of dividing the metropolis, guide-book fashion, into certain districts, it was thought better to take the buildings according to their several dates, commencing with the early English and mediæval, then the classical, and finish with the Italian and Palladian. According to this arrangement, the Tower of London first excited the deepest interest in our young friend; Westminster Abbey he thought finer than Notre Dame, but in parts inferior to Amiens or Beauvais; he rejoiced to hear of the intended restoration of the Chapter-house. The Temple Church, and that of St. Bartholomew the Great, in Smithfield, completed the list of ancient ecclesiastical structures. Of the modern, in mediæval fashion, we pointed out to him the Catholic Apostolic, in Gordon Square; All Saints, in Margaret Street; and St. Alban's, in Baldwin's Gardens, as three of the most important of a legion in this style. The first and last of these he considered of the highest merit, and was somewhat surprised that mass had not yet been performed in them, and that they were not

already under the jurisdiction of a Roman Catholic Bishop of London.

Of modern mediæval works, the Palace at Westminster of course stood in the first rank. Alphonse was some time before he hazarded the remark that the enrichments and ornamentations were laid on with too lavish a hand, and that, if some plain surfaces had been preserved, those portions which were enriched would, by contrast, have had an additional value. The Victoria Tower he considered as a *Capo d'Opera*. The buildings at the Broad Sanctuary he found most picturesque, and admirably adapted to the site, and the Crimean Memorial a most successful performance. The numerous attempts at mediævalism springing up so plentifully in all parts, excited the young French architect's greatest astonishment. He was told that by some it was called the Victoria school, to which he replied that it was well named, as it seemed to "*règne partout.*" Many shrugs of the shoulders were given as he passed these specimens of incongruous forms and elaborate workmanship rapidly in review, considering them generally as great monstrosities. The *Music* Hall in the Strand is said to be the crowning triumph of this school. My friend observed that its claims as to being a *chef d'œuvre* might be a question, but that, at all events, the architect had endeavoured to make it characteristic, and had shown his knowledge of the science of *thorough base*. There are, however, some specimens of this style which are deserving of praise; for instance, the schools in Endell Street, St. Giles's; some buildings on the west side of Bishopsgate Street; a house built for Messrs. Alexander, in Lombard Street; and more especially a house on the east side of Mincing Lane, near the south end.

Of Greek and classic buildings, we brought forward St. Pancras Church, in the New Road; the Propylean entrance to the North-Western Railway; the British Museum; and the Post Office in St. Martin's le Grand. The beautiful little façade and entrance to Melbourne House, Whitehall, may be added to the list.

We now approach the Italian and French school, and first of all stand the churches of Sir Christopher Wren, the several towers and spires of which had so delighted our young architect in his panoramic view from St. Paul's. With the interior of these churches he was equally delighted; the ingenuity displayed in adapting the buildings to old sites; the cleverness with which they are lighted; the appropriateness and freedom of the enrichment. The interiors, especially of St. Stephen's, Walbrook; St. Bride's; St. Laurence Jewry; and, more particularly, St. James's, Westminster, all impressed him with admiration at the genius of our great architect, and

with utter astonishment that fashion and false taste unfortunately prevail so much at the present day, that some of these beautiful interiors have been martyred at the hands of the mediævalists. Our friend, we think very justly, remarked upon the bald and incomplete appearance of the exterior of St. James's Church, Piccadilly; surely, in so wealthy a parish and royal neighbourhood, the necessary funds might readily be subscribed for the properly facing the walls with stone, and the raising a glorious tower and spire, to become as great an ornament to this quarter of London as the matchless spire of Bow Church is to the City. The church of St. Mary-le-Strand, and the glorious portico of St. Martin's, both by Gibbs, made a most favourable impression on our visitor; but, on proceeding to Whitehall, the view of the Banqueting House raised his enthusiasm to boiling heat. He jumped and clapped his hands for very joy, and pronounced it to be one of the finest works he had ever seen, either for the grandeur of the pile or the refinement and exquisite delicacy of the detail. From this fragment, judge what the effect would have been if the whole of the intended palace had been completed! Both the Escurial and the Louvre would have been inferior to it! The National Gallery and Trafalgar Square of course formed the subject of some criticism; and when it was asked how long the pedestal *vis-à-vis* to George IV. had been without its equestrian termination, and Nelson without his guardian lions, we pretended a little deafness, and hurried on to Pall Mall; here we felt more at ease, and took some little pride and pleasure in pointing out the several palatial clubs. This is certainly London's first street for architectural effect, occasioned very much by the buildings being insulated, and not mere *façades*, and the lines of some (the War Office, for instance), being set back with a *cortile* in front. The "Travellers'," the "Reform," and the "Carlton" were particularly pointed out; the former seemed to bear away the palm for grace and beauty. St. James's Palace was regarded more historically than architecturally interesting; but, as for Buckingham Palace, I don't know how many shrugs of disappointment our friend made, and, when he saw the equestrian statue in the distance, high in air, and heard that it was the Duke, he was appalled at such an outrage. He recovered somewhat in being shown Bridgewater House, and Lord Spencer's, adjoining; the one quite Palladian, the other of Rome's best period. A long discussion ensued as to their rival merits, resulting perhaps in favour of Spencer House as being the more graceful of the two.

The Marble Arch, in Hyde Park, was the next object we viewed, and our young friend was so jocose in his criticisms upon this work that we were positively ashamed that he should

have seen it. "What!" he exclaimed, "all this expensive material of marble, and no Quadriga, no statues, no inscriptions—nothing upon the columns but those wretched scrolled blocks which I believe are called trusses? If you are at a loss for a subject, send to Birmingham foundries for a car with a Victory riding over *Mayne force*. You need not wait till Sir Edwin and the Baron have finished Nelson's lions; for, as you prefer employing foreigners, we can spare you a corps of sculptors who would turn them out for you presto-presto."

Our companion, in his walk down Oxford-street, was much struck with the meanness of many of the houses at the south side of it, and suggested what a fine boulevard might have been formed when Oxford Road was converted into a street of shops. The Paris boulevards are about the most pleasing and agreeable thoroughfares of that most magnificent of all European cities, and our humble London does not produce one—a want which is ever to be deplored, as Tottenham Court Road, the Marylebone Road, the City Road, the Borough Road, and the thoroughfares leading from the Elephant and Castle to Lambeth, would all have been most applicable for the formation of boulevards. A detour from Oxford Street into Hanover Square was much to our tourist's taste. He considered the view of the Square and George Street, with the Church, as one of the most scenic in London; the street not being parallel, and several of the houses being built of red brick and stone dressings, in a quaint Queen Anne style, renders this part of London very picturesque. A ride from the Regent's Park down Portland Place and Regent Street elicited many remarks and shrugs of the shoulders from our observant companion. The first shrug was at the Lilliputian statue of the late Duke of Kent, at the termination of a spacious avenue. The new Langham Hotel could not be passed by without an observation of its gigantic size, putting all around into shade, and thoroughly extinguishing its neighbouring church and spire. The Circus and Regent Street were considered worthy of a much better class and style of house than what prevails. The Quadrant is not altogether a disagreeable feature, although it has been shorn of its colonnades.

Victoria Street, Westminster, now in progress, was seen by our young friend, who thought that in this case the houses were rather too high for the width of the street, and that at times we should feel it dark and gloomy. The buildings at the Grosvenor Place end, now being erected, are very superior in design to those in Victoria Street. They are quite French in character, with *Mansard* roofs, terra cotta enrichments, and ornamental zinc-work on the curbed roofs. Our friend thought that one of his countrymen must have been employed; but

we believe that the Marquis of Westminster entrusted his London architect with the work with the request that the style should be Parisian in character. When completed, the Marquis will have every reason to be proud of his estate as being one of the most attractive in London. Montague House was much to our young friend's taste. The new Foreign Office and the *façade* of the Treasury elicited no favourable expression. The screen of the Admiralty especially delighted him, but he complained sorely of the removal of the columns to form side entrances. We do not think our young architect agreed with our boastful expression that Trafalgar Square was "*the finest site in Europe.*" It possibly might have become so had a Visconti been engaged on it; but with its National Gallery, College of Physicians, its puerile fountains, its pedestal without an equestrian figure, and the base of Nelson's Column still bare of the joint productions of the pet painter and the titled Italian sculptor, made us quite ashamed of our position as *cicerone*. Our friend saw our distress, and adroitly expressed his admiration of the statue and pedestal of Charles the First, and the fine portico of St. Martin's Church. The latter, he remarked, from its skilful arrangement of plan appeared to him infinitely larger than its real dimensions would warrant. The Charing Cross Hotel was found rather too *prononcé*, and the erection of the Eleanor Cross only to be excused on archæological grounds. Somerset House was next pointed out, and greatly delighted our friend by its grandeur of outline towards the Strand, and the exquisite detail of its enrichments; the *cortile* and *façade* towards the river he did not so much approve of, but the new portion in Wellington Street he considered as most successful. *En route* to the City, Temple Bar he thought inferior to the Porte St. Denis, but at the same time clever and picturesque. Fleet Street displeased him, and he asked us to compare a pretentious example of the fashionable Victoria style, exhibited in the Crown Insurance Office, next to St. Dunstan's Church, and a little architectural gem, the London and Provincial Law Assurance Office, on the opposite side—the one protruding in boldness of deformity,* the other retiring in delicacy and beauty worthy of a Peruzzi. Turning into Chancery Lane, young Mansard was quite charmed with the exquisite *façade* of the Law Fire Office, which, in his opinion, had more of the refinement of Vignola than any building he had seen in London. The Law Institution did not produce any favourable criticism, but the

* Our Critic will find many who dissent from his strictures on the Crown Life Office; but, having long made Architecture a profound study, and being the Author of one of our most beautiful recent buildings he is well entitled to be heard.—Ed.

Union Bank, at the corner of Carey Street, he considered of great merit, and somewhat Parisian in character. Ludgate Hill was pronounced as a picturesque approach to St. Paul's, particularly in respect of St. Martin's Church, with its elegant and unpretending spire. The Railway Bridge was abominable, and we believe there was an expression of something very like *sacre* when it first came into view. St. Paul's has been already remarked upon. The neighbouring Hall of Christ's Hospital was much approved. The Post Office and Goldsmith's Hall were both striking; Guildhall by no means worthy of the first city of the world—the Continental Hotels de Ville eclipse it entirely. The *façade* of Mercers' Hall detained our young friend for some time, and we felt somewhat humbled at not being able to inform our inquirer the name of the architect. The Mansion-House he thought noble and striking. The Portico of the Royal Exchange met his approval, but the pretentious gigantic erection immediately opposite, and soaring above it, produced an exclamation which was anything but that of approval. Why the Bank itself should be so low a structure surprised him, but the circular end of the Bank, at Princes Street and Lothbury, excited the greatest delight; he considered it perfectly unique—a choice specimen of taste and genius. Adjoining Lothbury we found the New Auction Mart, quite Venetian in character, evidently by a master hand—the same, we believe, that has given us the noble *façade* of Munt and Brown's warehouse in Wood Street. The new Insurance Office, on the site of the former Auction Mart, was passed in silence; but the noble erection, the Sun Fire Office, at the corner of Bartholomew Lane and Threadneedle Street, was recognized as one of the most successful works of the most accomplished architect the present century has produced. Our young friend hardly knew which most to admire—the beautiful effect of the mass, or the exquisite taste of the ornamentation, the proportion of ornament to plain surface, and the character and suitableness of the ornaments themselves. Proceeding along Broad Street, a number of modern erections, mostly in stone, present themselves. They are not generally of great merit, save and excepting the Imperial Fire Office. The large pile opposite the City Club quite enraged our French visitor that so golden an opportunity should have been lost. "*Detestable!*" was all he muttered. The new National Provincial Bank, in Bishopsgate Street, put our friend in good humour. It is by the same talented hand that produced the Imperial. This is certainly one of the best attempts at classic architecture that we have in the Metropolis, and the liberal application of appropriate sculpture in the design gives an appearance of Roman magnificence.

We must not neglect Lombard Street, which has been more changed of late by the architect than almost any other street in London. The London and County, Robart's, and Barclay's Banks are all solid and important structures, but why stone was not employed throughout in the two last we are at a loss to discover, for we feel quite certain that no question of expense interfered. The Royal Insurance at the corner of Nicholas Lane is a design that has evidently been carefully studied, and the enrichments are in a great measure Greek in character and feeling.

In Fenchurch Street, Mincing Lane, Mark Lane, Seething Lane, Billiter Street, Tower Street, many new buildings of importance have been built of late years, and many are still in progress; in their style it appears to be a race between the mediævalists and the Italian. The first revelling in colour, red, black, white, and yellow, with a superfluity of carving, in which the London sparrows will build many a comfortable abode; the other, the Italian, also indulging in much ornamentation, and looking rather to Venice than to Rome for examples. With the exception of polished granite, the sober colour of Portland stone appears to satisfy the designers.

We must not quit the City without a glance at the National Provident Office at the corner of Eastcheap, designed by the Professor of Architecture to King's College. It is a very striking building, and courts approval; the principal entrance is well and ably designed. The monument with its noble pedestal and happy termination excited much more attention from the Paris architect than the column and lionless pedestal in Trafalgar Square. We were glad to take boat after our long pedestrian exercise, and with an approving glance at Fishmonger's Hall. We had an opportunity in our voyage to observe the magnificent span of the centre arch of the Southwark Bridge, and what engineers are attempting to do with the *square* instead of the *arched* openings at Allhallows and Blackfriars; we observed also with much regret how much the Railway Termini next the banks completely crush and dwarf all the surrounding buildings. The embankment in progress of course was a source of great interest, and we agreed that from what we could judge, the work was poor and tame, and more suited to the banks of the Cam or the Isis than to the shores of old father Thames. The architect of York Gateway and Stairs would have adopted a bolder and more characteristic wall of masonry, and with a nobler parapet than the ill constructed one at Westminster Bridge Stairs. Landing on the Surrey side we had a good opportunity of observing the superb effect arising from the great width of the new bridge at Westminster and although the City Engineer, as a utilita-

rian, considers that two bridges of a moderate width would be preferable to one wide one, we decidedly gave our vote here in favour of the broad guage principle. On looking over the parapet we hope we were mistaken as to a feeling of vibration.

The site for the new St. Thomas's Hospital was pointed out to our visitor, and the plan of the buildings explained to him. We believe he was more engaged in thinking of "Les Invalides" on the Seine, than the proposed pavilion hospital on the Thames, for "he made no sign." We returned by London's "silent highway" to London bridge, noticing a large stock of warehouses on the Surrey side with a Venetian façade next the river, and the fine old Tower of St. Mary Overys rose in far greater dignity than more recent piles. We completed our days' lionizing by taking our places from Moorgate Street in one of the comfortable carriages of the Metropolitan Railway, and our *underground* works, and particularly the station connecting the line with the Great Northern, were considered by our young friend as being of far superior merit to many of our works *aboveground;* the admirable plan and arrangements, the excellent and careful construction, and the good taste of the architectural features impressed our visitor with a strong feeling of admiration for the talent displayed by the engineer of this most important work.

Upon our return home in the evening we chatted over what we had seen; and with regard to the architecture of cities, I think we came to a cordial agreement that for the general view from the environs, domes, and towers, and spires are most desirable, as witnessed in the beautiful effects produced in the large eastern cities from the outlines of the domes of mosques and by the minarets. Our next point was that open spaces are indispensable, and that they should intersect or be in close continuity with long lines of thoroughfare, as in Regent Circus and Cavendish and Hanover Squares, in respect of Oxford Street. Perhaps the finest open space in London is Lincoln's Inn Fields, disgraced by three of the most inferior entrances, and the inlets from Holborn by *two turnstiles.*

That streets should not always be laid out at right angles, but that diagonal streets should be introduced as being favourable to the traffic, and as giving variety to the different points of view must be conceded. Nothing we conceive can be more monotonous than the laying out of New York in square blocks, *ad infinitum.* Lines of thoroughfare need not always be straight. The width of streets should not exceed eighty feet. Pall Mall appears to us perfection for a street with important buildings; an excess of width occasions the buildings to look low, and dwarfed, and are most inconvenient for passengers to

cross. Paved covered ways, as in Paris, are most desirable. Having agreed upon these points, we now, to our dismay, approached the subject of public fountains, and our companion inquired why we had not pointed out in our rambles some of the many which he understood had lately been erected; we never felt more ashamed in being obliged to reply that we could not point out a single one deserving his notice, and that we had purposely avoided what we had hoped he had overlooked. Our friend saw our chagrin, and referring to the architecture of our recent buildings, he observed that he thought our mediævalists had run wild in their productions; that buildings of that style when carefully studied and not caricatured were most picturesque, and formed a pleasing contrast with the classic and Italian; that in respect of our Italian designs they were in most instances wanting in the careful study, which is expected from the hands of a travelled and accomplished architect.

The last day of our friend's visit was reserved for a *bonne bouche;* a *déjeûné à la fourchette* at Richmond; a visit of course to the Tunnel, and a white bait finale at Greenwich, with a previous two hours round the Hospital, followed by a glorious sunset, completely smoothed down all the little disappointments he had met with in our street architecture. We made our adieux at the London and Dover Railway Station, with a promise on our parts to make the return visit to Paris next year at the great National exposition.

THE BLACK POPULATION OF THE BRITISH COLONY OF NATAL, SOUTH AFRICA.

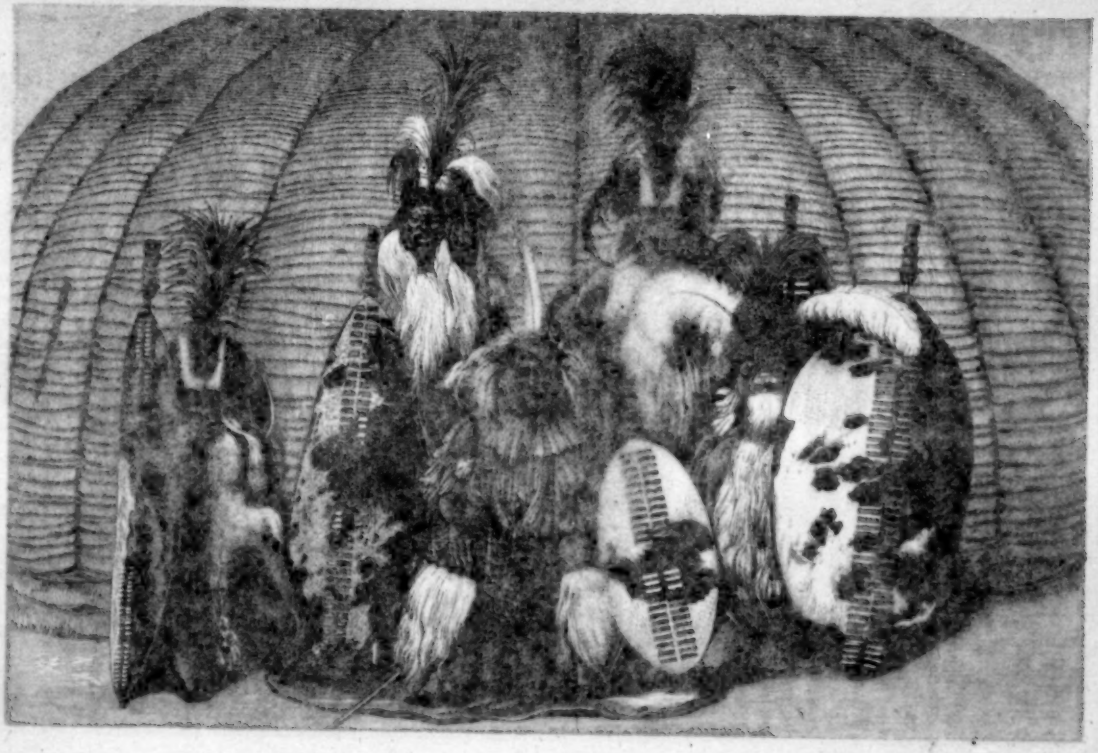
A PRELIMINARY SKETCH.

BY ROBERT JAMES MANN, M.D., F.R.A.S.,
Superintendent of Education in Natal.

(With a Tinted Plate).

THE British Colony of Natal lies on the south-eastern coast of Africa, about eight hundred miles beyond the Cape of Good Hope, and reaches upwards to within a little more than two hundred miles of the southern tropic. It is a strip of land included between the high Drakenberg step of mountains, which forms the threshold of the great continent, and the Indian ocean. Its sea-board is one hundred and fifty miles long, and its depth from the sea to the mountains, an extent varying from one hundred to one hundred and forty miles.

Natal, thus placed, is the very middle of what Dr. Livingstone and the geographers have termed the "Kaffir zone" of climate, as distinguished from the Bechuana and Namaqua zones beyond the mountains. This zone was inhabited, before the land was visited by Dutch, Portuguese, or Englishmen, by a distinct race of people, whose direct descendants now form the black population of the Colony. The land was first seen by European eyes on the 25th of December, 1497, when the renowned Portuguese navigator, Vasco de Gama, touched at it on his first voyage to India round the cape, and named it the "Terra Natalis," in honour of the day. The soil was first trodden by British feet in the year 1683, when a crew of men who had been shipwrecked further north, near the spot now known as Delagoa Bay, made their way through it to the Cape of Good Hope. Three years subsequently a Dutch ship was wrecked where the Port of Natal is now established, and the stranded crew spent twelve months on the shore, and at last built a small vessel from the fragments of the wreck, and sailed away for the Cape of Good Hope, leaving, however, three Englishmen and a Frenchman behind. These were finally taken away, after a longer residence, by a Dutch vessel visiting the coast; but they carried with them reports of the place which led to the Dutch forming a settlement there in the year 1721. The settlement, however, was maintained for only a brief period, and then abandoned. In the year 1823, Lieutenant Farewell of the Marines in the progress of a surveying voyage, visited the site of the old settlement. On the following year he led



MOORU CHIEFS.

back a band of twenty Englishmen, who proposed to acquire territory there, through friendly negotiations with the native chiefs. These pioneer settlers maintained varying relations with the natives in the subsequent years, sometimes retiring southwards to avoid the consequences of disagreements, at others returning to the neighbourhood of the Bay now known as the harbour of Durban. Twelve years after their first arrival a party of Dutchmen came down from the mountains in the interior and joined them. Their successors founded the towns of Durban and Maritzburg in the year 1839, and from that time until the year 1842, there was a period of dispute and strife between the Dutch immigrants and the British Government, which claimed allegiance from them in consequence of their being emigrants from the Cape Colony. The dispute was finally adjusted in this year, and in the year 1845, the first British Lieutenant-Governor was installed in Natal.

When the Portuguese and Dutch first visited Natal they found the land thickly peopled by a black race of friendly and gentle temper. The race was divided into separate communities, which lived in a quiet orderly way under distinct chieftains. When Lieutenant Farewell came to Natal, in 1824, matters were greatly changed. A warlike chieftain to the North had drawn together many separate clans under his dominion, and formed them into an army of aggression. With this army he had moved down towards the south, subjugating the land, and either carrying away the remnants of the conquered tribes, to incorporate them among his followers, or driving them before him as scattered fugitives. The tribe which first began this career of conquest and absorption, was a small clan located some distance to the north of the Tugela. It was then known as the Zulu tribe, and accordingly in its aggrandized state it still kept the designation of Zulu. The warlike chief who struck out the bright idea of extended rule bore the name of Chaka, a name which remains a potent spell among the Kaffirs even at the present time. Wherever there was black mail to be levied, or an independent clan to be eaten up, this warlike chieftain led the short javelins and stealthy steps of his disciplined warriors, until by degrees his sway extended from Delagoa Bay in the north to the great river of St. John in the south, and Zululand became a wide kingdom five hundred miles across. When Lieutenant Farewell landed his small expedition in Natal, Chaka was at the summit of his power, and had a large military kraal on the banks of the Umhlali, twenty-five miles within the boundary of what is now the colony. A few fugitives of the original Kaffir tribes lurked in concealment in the bush, as the sole representatives of the once teeming population; culti-

vating small patches of maize in hidden ravines, or living upon wild roots and shell-fish. Beyond the military posts of the Zulu conqueror the entire country was a desert.

After some preliminary negotiation, Chaka gave the English settlers permission to occupy territory at the Bay, and promised them his protection. One of the settlers, Mr. H. Fynn, was raised to the dignity of subordinate chieftainship. In the year 1828 Chaka's term of power came to a violent end. He was murdered at the instigation of his brother Dingaan, who thereupon proceeded to throw the royal skin over his own shoulders, and as one of the first acts of his rule, summoned all chieftains, who had shown fidelity to his brother, to appear before him. Mr. Fynn knew too well what this meant, to obey the summons; and retired with his followers beyond the Umzinkulu, until he was able to come to an understanding with Dingaan. He returned in 1831, and was then recognized by Dingaan as the "Great Chief" of the Zulu Kaffirs.

So early as the year 1827, refugee Kaffirs had commenced to return into Natal under the guarantee afforded by the presence of the pale faces. Some of these refugees came from the north, and some from the south. The influx now increased. In 1836 there were 1000 adult male Kaffirs in Natal, able to bear the shield and assegai, and paying allegiance to the English. Two years subsequently the white chiefs could muster a following of 2100 armed Kaffirs. The Kaffir population at that time numbered 10,000 individuals, men, women, and children.

It was in this year, 1836, that the party of Dutch emigrants, under the guidance of Jacobus Uys, Hendrick Potgieter, and Pieter Reiteif, descended into Natal by a central pass which Reiteif had discovered through the Drakenberg Mountains. From this time fresh accessions of Dutch rapidly flowed down, and a period of conflict between these Dutch pioneers, and the Zulu chieftain ensued; which, after a series of vicissitudes, ended finally in the year 1839, in the destruction of Dingaan, after a signal defeat of his regiments, and in the establishment of Umpanda, the brother of Dingaan, who had been for some time a fugitive in the Natal territory, as supreme chief of the Zulus. Umpanda assumed his seat on the principles of white alliance, and in the interests of peace. He paid a subsidy of 36,000 head of cattle to the Dutch when he began his reign.

The Dutch settlers in their turn became involved in disputes with the British Government, as has already been stated. When, in the year 1842, the Dutch flag finally went down before the British, and the Dutchmen within the Natalian territory became subjects of the British Crown, the friendly

allegiance of the peaceful chief Umpanda was transferred to the new masters.

Umpanda still sits in his big royal kraal beyond the Tugela River, which has been established as the boundary that separates the British territory from independent Zululand, surrounded by his wives and children, and by his flocks and herds; and sends ambassadors over from time to time to confer with the Colonial authorities, and get their advice on matters of delicacy and difficulty. But Umpanda's days have not been altogether roseate ones. Umpanda is now a very portly potentate, and a martyr to gout. He has to be dragged about upon wheels, and when he enters upon a journey his attendants take off the front wheels of his travelling waggon, and slide the royal body up; and then lift up the waggon by sheer force to re-insert the wheels upon the axle. Now, an invalid and obese king, thus absolutely dependent upon the care of his people, is very convenient and satisfactory to peaceable neighbours, but, in another sense, not altogether qualified to fulfil the cravings of a glorious tradition. Umpanda and his cart do not glitter in young Zulu eyes, when young Zulu ears have heard of the stride of the conquering Chaka, at the head of his light-footed legions. Since Chaka's time it has been the custom to band all male Zulus above adult age into regiments, and to bring these regiments in succession to the royal kraals for service. The ordinary service consists mainly in building huts and fences, and in milking and herding the cows belonging to the king. The captains and chief men of the regiments reside in huts appointed to them by the king, but receive their daily food from their own people. They have a claim, however, to certain gratuities of cattle as a guerdon for the service.

In Chaka's time there was no difficulty about these gratuities; there was then constant war, and the spoils of the vanquished readily furnished the royal pay. Umpanda, on the other hand, has no extrinsic supply of this character to draw upon. He rules in the interest of peace, and has to rely entirely upon his own internal resources to meet the expenses of his state. Consequently, the chief men assembled at his place, commonly return to their kraals empty-handed, at the end of their terms of service. Some time since, as a measure of state economy, the king gave his eldest sons permission to found kraals of their own, and to go to reside in them. A natural result of this combination of circumstances has been that these kraals have come to be the resort of dissatisfied and disaffected men, who attach themselves to the persons of the young chieftains, and encourage them to set up on their own account. This is technically termed "living

under the tiger's tail." Through a series of years the parties of the young chieftains have been waxing in strength, and the old king has been left more and more to his gout and his old councillors. The young chiefs have, of course, been growing more jealous of each other as they have waxed in power, and more especially as it has come to be known that Umpanda has inclined to favour his younger sons in preference to his first-born. In the year 1856 there was a great fight between the party of the elder son, Ketchwayo, and that of the younger brothers, in which Umbulazi and five others of the younger sons were slain. Since then the fortunes of Ketchwayo have been in the ascendant. The person of the old king is respected, and he continues to live, surrounded by his old men, at his kraal; but it is understood that he is now too old "to move," and is only to do "the thinking." Umpanda is "*the head*" of the tribe, but Ketchwayo is its "*feet.*" Two others of the younger sons of Umpanda escaped with their mothers from Zululand at the time of the great fight, and are now living as refugees in Natal under the British ægis. The brothers who remain on the Zulu side of the Tugela are considered to be adherents of Ketchwayo.

One important consequence of this curious passage of Zulu history is, that the 10,000 Natal Kaffirs of 1836, have grown into 200,000 Natal Kaffirs in 1866. Year after year, more and more of the men who had primarily sided with the younger brothers, and more and more of the middle-aged and sedate Kaffirs who have longed for quiet and peace, have passed over the border as opportunity served them, and settled themselves down among the black subjects of the British Queen. These refugees are required to enter upon three years' term of service, whenever their presence is recognized; but sooner or later they all become absorbed into the following of one or other of the petty chieftains who are distributed over the land. There are certain districts set apart as reserves for these clans, where they are allowed to live under the condition of paying a small yearly hut tax to the Government, and yielding obedience to the magistrates and laws. But many of them have built their kraals on the lands held by private proprietors, or on the lands yet in possession of the crown. In the former case they pay a small rent to the landlord, or furnish an equivalent in the form of personal service.

The black population of Natal thus consists of numerous small tribes, living under their own separate chiefs, and scattered abroad over the face of the land, either in reserves which are set apart by the Government for their occupation, or as squatters upon the crown land and private estates. These tribes are primarily formed of the original natives of the

district, who were driven away from their hill-sides at the time of the Zulu invasion, but who returned when the colony came under the protection of European occupation and British rule, and have since been largely reinforced by successive additions of refugees from Zululand, who were themselves for the most part, it will be remembered, originally drawn from the same aboriginal source. These people are now all liege subjects of the Queen of Great Britain, and already partake in a large measure of the advantages of British rule. But they are nevertheless still barbarians in the mass; and here, therefore, arises the most momentous and deeply interesting question, What is to be done with their black bodies and barbarous minds? what is to become of them in the future? There can be no doubt they will not remain where they are as barbarians. Nature herself, and the immutable laws of human existence, have decided that this cannot be; civilization and barbarism cannot continue to look into each other's eyes at close quarters. Whenever they have been brought face to face by circumstances, one of two things has always taken place—either the barbarians have disappeared from their place upon the earth, or they have been drawn within the civilized pale, and turned to account. Which of these fates is it, then, that is in store for these black tribes of Natal? Are they to find, under the altered circumstances of their land, and after their escape from the thraldom of a savage tyranny, extermination or a new life?

In endeavouring to catch the first faint whisperings of the answer to this question, the inquirer is met by a stubborn fact, which undoubtedly has its meaning. Up to this time the results of the meeting certainly has not been in the direction of the extermination alternative. The 10,000 Natal Kaffirs of 1836, are 200,000 Natal Kaffirs in 1866! Under the ægis of British protection, and in the face of European civilization, the black race of Natal has increased twenty-fold in thirty years. This certainly looks very much indeed as if there is no early extermination to be thought of. It looks, indeed, as if the other alternative is the thing that is in progress, and must be brought about.

Before entering further upon the consideration of what indications there are that the civilization and utilization of the Natal Kaffirs, are possible and in progress, it is absolutely essential here to get some clear notion of what the uncivilized Kaffir is, upon whom the civilizing operation has to be performed. We must pause for a passing glance of scrutiny at the raw material before we entangle ourselves too deeply in the processes of the manufacture.

The Kaffir who is found in Natal, is, upon the average, of

somewhat lower stature than the Englishman; but he has a well-proportioned and well-developed frame, of slim rather than robust dimensions, and, as a rule, more fitted for the exertion of activity than of strength. There is more of the Mercury than of the Hercules about him. He has black wool upon his head in the place of hair, and very commonly he has the large protruding mouth, thick lips, and broad flat nose of the negro type of organization, as shown in the accompanying very characteristic portrait taken from the life. But occasionally he has the narrow aquiline nose, straight lip, long beard, retiring chin, and square prominent forehead of the European.

BUST OF KAFFIR.

His eye is for the most part dark, soft, and twinkling with merry humour, and his face stamped with an open, gentle, and amiable expression. The few observers who made his acquaintance before the days of Chaka's military despotism always spoke of him as being gentle and amiable in character.

The small-boned and slender limbs of the Kaffir, already alluded to, at once distinguish him from his cousins of the negro variety of the dark skinned African family. In young individuals and among the boys, the tapering, delicate arms and hands, slim legs, and slight feet are so remarkable that they catch the attention of the most careless observer. In all probability he has some substratum of the coarse-grained,

light-hearted, and grotesque negro in his organization; but this organization obviously vibrates between that fundamental and some nobler type. His habits and tastes point to this conclusion as forcibly as his frame. His propensities are pastoral and nomadic. He loves to have fat oxen and grazing goats about his kraal, and to wander from hill side to hill side. A stroll of fifty miles is pastime to him in a fine season. He has an inherent impatience of constraint in any form. Chaka could never have made his invading and conquering armies out of negroes.

In his wild, free state the Kaffir goes entirely naked. He has no other garment than a bunch of strips cut from the skin of a sheep, a wild-cat, or a goat, and suspended from a slender girdle as a kind of diminutive apron. He wears, however, an apron behind as well as in front, and indeed deems the posterior one the more essential covering of the two. If he has had the good fortune to win distinction in the eyes of his chief, he puts on a collar of merit upon his neck, composed of the teeth and claws of the lion and leopard, or of the claws of the eagle, and circlets of bright brass upon his arms. In some instances a necklace of fragments of certain kinds of roots takes the place of the teeth and claws. He pierces the lobes of his ears with wide gashes, which he then ornaments with knobs carved out of fragments of bone, or uses as the depository of his snuff boxes constructed from tubes of reed. He hardly ever moves from his hut without having his buckler of ox-skin upon his arm, and a bundle of five or six assegais, and a knobbed stick, or club of hard wood in his hands. Most probably this habit was primarily due to the risk he was exposed to of having to encounter some fierce wild animal at any instant. At night he lies down on the floor of his hut, and there wraps himself in a well-greased ox-skin, now often exchanged for a woollen blanket of English manufacture.

Although the wild Kaffir has so scanty a wardrobe for the ordinary purposes of life, it must not, however, be supposed that he is indifferent to the graces of personal adornment. He has plumed and furred robes of considerable complexity for ceremony and for war. Our plate gives a portrait, from the life, of the Natal Government chief Ngoza, with four of his men, in heavy war costume, in front of his hut. Ngoza is sitting in the middle. His head-dress is made of circlets and pendants of furred skins, with a crane's feather on the crest; his breast-plate is a tippet of tails of monkey-skins. His apron is mingled goat-skin and monkey-skin, and his greaves are fashioned from the skin of the white ox. The tall plumes of the attendants are of the feathers of the crane. The shields are dried ox-skins very artistically stretched on wooden frames,

and diversified by the natural white, black, and brown patches of the hide. Ngoza has a plume of scarlet ostrich feathers in his wardrobe, which he prepared on the occasion of the visit of Prince Alfred to the colony, at a cost of thirty pounds. Ngoza is not an hereditary chieftain. He has won his spurs by faithful service to the British Government. He was placed over a heterogeneous assemblage of refugees some years ago, and now lives in a large kraal within sixteen miles of Maritzburg, and assembles a considerable following under his command whenever any special service is required by the Government. He appeared before Prince Alfred with four thousand armed men, and entertained him with an exhibition of the native ceremonial dance on a very imposing scale.

The Kaffir women are certainly of inferior organization to the men. Occasionally young girls of a comely presence are encountered. But as a rule they are far more coarse and repulsive in their aspect than the men, and they always shrivel and wither at a very early age, unless when they take to the scarcely less objectionable proceeding of turning themselves into unwieldy bundles of fat. I incline myself to think that the life of inferiority and drudgery to which the native woman is born acts through successive generations upon her frame, and brings about a real degradation in her physical organization. The Kaffir is fond of his women, but he is fond of them in very much the same fashion that he is fond of the cows, for which he barters them away. The men reserve their thews and their energies for war and for the chase. They take care of the cattle, milk the cows, build the huts, and cut down timber with the axe. But with the exception of these light tasks, which are all honourable and dignified occupations in their eyes, they engage in no kind of labour. The women do all the real work of life. They till the ground, and sow and reap the grain; prepare the food; fetch the wood and water; keep the house in repair; and carry all the burthens. It is a matter of quite common occurrence in the open country of Natal to meet a young lord of the black creation marching along the path with an erect head and a jaunty step, his ankles encircled with little fringes of white skin,—that look as if they must necessarily soon bud with winglets to establish beyond all cavil his kinship to the messenger of the old classic Olympus,—and his hands filled with assegais, while immediately behind him march in single file three or four naked women bearing on their heads the load of his household gods; rolls of his sleeping mats; pots filled with beer; bundles of tobacco, and other prime necessaries that need to be transported in his steps. The young girls in their wild state go even more naked than the men. At festive times they are adorned with necklaces and

anklets of beads, and with broad fringed belts of beads that are arranged not untastefully across their hips. When they become wives and mothers they adopt a matronly costume, which consists of a short petticoat extending from the waist to the knee. With advancing years the petticoated wives and mothers pass rapidly into petticoated hags.

Such, in general outline, is the nature of the raw material; such is the Kaffir of Natal in his wild state, and in his simple bodily aspect. There is something more to be said of what lies a little deeper than the outward skin, for barbarian as the wild Kaffir naturally is, he is nevertheless subjected to the influence of a certain kind of culture and training even in his most savage condition. His education properly begins even before he falls within the sphere of the white man's operations. This topic, however, must be reserved for a future occasion.

EXPLANATION OF PLATE.

The engraving represents the group of Ngoza and four of his attendants, alluded to at page 191. The background is formed of the chief's principal huts, in a large kraal near the Maritzburg Table Mountain. The engraving is made from a photograph by Mr. Bowman, of Natal, and is therefore a very exact representation of Kaffir military costume. The tails of the dress are formed of strips of furred skin, often spirally curled after they have been cut. The feathers have necessarily lost some of their distinctness and splendour in delineation, in consequence of movement communicated to their light pinnæ by the wind. The greaves on the chief's legs are not altogether up to the mark. The right thing is that they should be formed of the actual tails of white oxen! It is probable that oxen are not now slaughtered upon quite so large a scale in Natal as when hostile raids and war were more the order of the day; and hence even wealthy chieftains are put to some shifts to keep up a due appearance in the altered state of affairs. Ngoza has, as mentioned above, one head-dress, which he provided, on the occasion of Prince Alfred's visit, at a cost of £30. It is principally composed of ostrich feathers, dyed crimson. He did not chance to be wearing this particular piece of costume when the group of the engraving was taken.

THE PLANET SATURN.

(CONTINUED.)

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

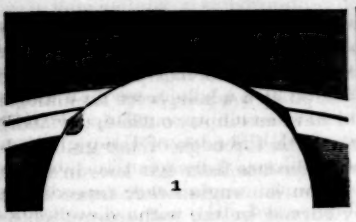
FROM an early period, irregularities have been remarked in the form of the shadows which the globe and ring mutually cast upon each other. As far back as 1792, Dec. 26, when Schröter was first trying his 13ft. reflector, he noticed a jagged outline to each of these shadows, which was confirmed, Jan. 18. —Next we find Lassell, during an "unequalled view," 1849, Aug. 3, describing the shadow on the ball as "evidently knotted or notched," as though there were mountains on the ring intercepting portions of the shadow, and "almost breaking it up into a line of dots:" an appearance which he again noticed with a similar opening of the ring, 1861. He had also seen it serrated, 1850, Nov. 21. So did De la Rue, repeatedly in the spring of 1861, and very distinctly April 7, with his 13 in. reflector and a very fine $4\frac{1}{2}$ in. achromatic; the "very irregular" outline was however figured by him as belonging to the edge of the shadow, not of the ring, as Lassell. So did Jacob several times, 1861, especially May 19, with $3\frac{7}{10}$ in.; he thought it might be an illusion from the apparent projection of parts of the shadow darker than the rest; an idea even more unintelligible than the difficulty which it professes to remedy. Lassell also at Malta, 1862, Jan., found the shadow a rough line. The little roughnesses, it is true, which Huggins suspected, 1862, especially May 18, on the S. edge of the dark side of the ring, always entirely disappeared, leaving a perfectly smooth edge, under powers of 600 to 950. But this, though it suggests caution, does not negative the previous testimony. The fact is sufficiently clear, and sufficiently perplexing. Such irregularities could only, it would seem, be occasioned either, 1, by corresponding unevennesses on the ring; or, 2, by a fretted and honeycombed structure of the surface of the globe; or, 3, by very great irregularity of refraction through the ring's atmosphere (that of the ball not being distant enough). Now, if the ring were studded with mountains of sufficient size, they would be very visible in its edgewise projection upon the sky, and, unless rotation is given up, would be distinguishable by their rapid motion from the lucid points so often mentioned. If a highly irregular surface of the globe were suggested, still our eye is never sufficiently far removed from the direction of illumination to see any marked effect in the form of the shadow; and the supposition of

irregular refraction seems too extravagant to be admissible on such slender data.

But if we pass over this difficulty as insoluble, we have yet to encounter a still more obstinate one in accounting for the abnormal character of the shadow of the ball projected upon the ring. If the latter, considered as a whole, were an uniform plane, the shadow on it would have an elliptic outline, deviating more or less from parallelism with the edge of the globe, according to the greater or less difference between the direction of illumination and that of vision (an angle never exceeding a small amount), but invariably curved in the same direction as the limb, and perfectly smooth. That the ring is not an uniform plane we have seen reason to believe, and we are so far prepared to expect some slight deviations, but only such as would be consistent with the extreme thinness, not only of the ring, but even of its apparent protuberances, at the epoch of lateral presentation. Now for the facts.*

We have already seen that, as long ago as 1792, Schröter perceived an unevenness in the shadow, not only upon the ball, but particularly, he says, upon the ring, where it was especially distinguishable by a projecting portion of the light of A. The next mention seems to be by H, 1806, June 9, whose description of it does not, however, specify that feature of his diagram which would now be thought most curious—the reversed curvatures of the limb and its shadow. Then after a long interval, 1850, Lassell, Dawes, and Secchi saw the outline of the shadow slightly concave towards the ball. Dawes thought that it might be an illusion from contrast with the limb, or B might be wedge-shaped, though then it would be hard to account for its edgewise disappearance. Secchi referred it to a slight convexity of B, experiment proving that a very slight one would suffice; or in some degree, possibly, to difference of planes.—1851, Sept. 5, Bond I. found the outline straight, or a little concave. 9, Lassell ditto. 10, slightly concave. 25, Dawes found the shadow on A irregular.—1852, Oct. 5 to middle, Lassell (Malta) saw a "remarkable sudden projection" of the shadow in crossing Ball's div., and an elongated spot on B on the opposite (*f*) side, close to the limb, sometimes, but not generally, extending to the division; this, he afterwards perceived, was the germ of the coming shadow on that side, as our eye travelled across the direction of illumination at the opposition. 22, shadow on both sides ball: Bond II. 28, ditto; 2 *wings* on B also fancied: Bond II. Nov. 3, shadow on both sides; "what can this mean?" C. W. Tuttle; also B.

* Secchi alludes to Cassini and Messier as having inferred, from observation, a curved surface for the ring. I am not able to say whether this may signify anything more than the irregularities of the edge-view.



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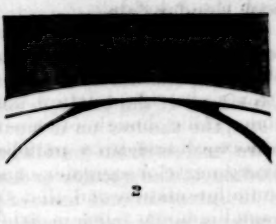

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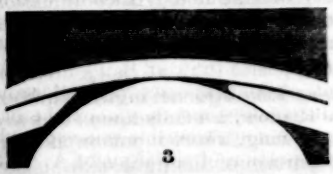

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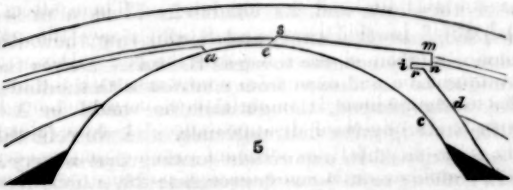

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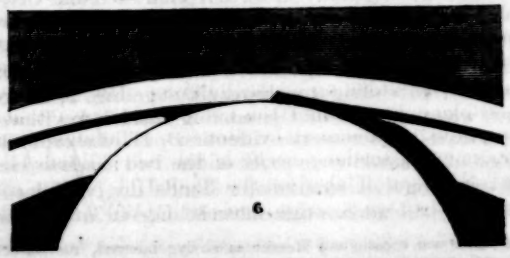

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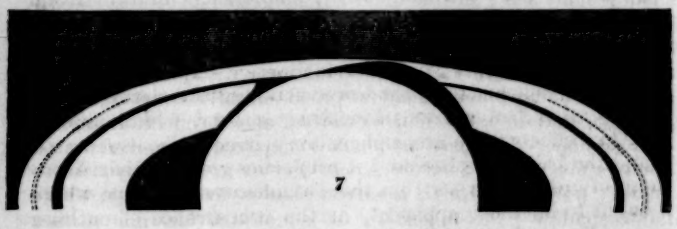
II., and Nov. 4. 15, Lassell, the shadow had changed sides, and the "sudden projection" lingered as a similar spot *p*, so that there was shadow, though on B only, on both sides of the ball. In this month De la Rue drew the shadow *f*, with a strong discontinuity at the division, as though A lay above B (inverted). 29, on both sides, much plainer *f*; "This is very remarkable, but there can be no question as to the fact:" both like objects seen by mirage: B. I. See the diagram, Fig 1. The American memoir contains no less than 40 views in which some peculiarity of the shadow is represented, from which Figs. 1, 2, 3, 5, 6, 7 have been selected, with regret at the omission of many others equally curious, especially as the work is very little known in England. Dec. 1, *p* shadow seems to adhere to and partially overlap limb; in continuation of a dusky belt, but much darker: B. II.—1853, Jan. 8, a singular dusky spot adhering to *p* limb, as often before; *f* shadow almost makes a corner opposite to it, at Ball's div.: B. II. Oct. 24, 25, Nov. 2, Dawes saw little triangular spot *f*, just within division, considerable breadth of shadow *p*, concave to limb on B, convex* on A, and much further out on B than A, so as to make a notch at division, as though in two planes. [His drawing singularly like our Fig. 1, but reversed, and placing the small spot close to the division.]—1854, Feb. 12, and later, Hippisley observed the shadow on B conspicuously concave towards the ball, so that it should have passed over much of A, if in the same plane; this ring, however, was untouched: it seemed as though B had a convex surface. From computation and experiment he found that, allowing for polar flattening (which is material), the shade on A would have been hidden by the ball, especially if A were in the least above B. But he does not allude to the reversed curvature. Sept. 26, *p* shadow on B nearly straight; 29, a little recurved, with a small projection *f* close to division: Dawes. Nov. 23, S. region of globe (now coinciding with Ball's div.), or adjoining part of ring, singularly distorted. On each side of globe a slight shading on B, turning out right and left in 2 *corners* along division, which is quite flat between them: B. II.; Coolidge, with 5 ft., ditto. Nov. 26, Dec. 7, angular projection on both sides, up to Ball's div., something like our Fig. 2, but equally black and blunted on either hand. A unshaded: Dawes. 9, flattening of S. regions very evident: B. II. Later, and much finer air, a new distortion; *horns* of the two shadows certainly concave: S. edge of shadow (or Ball's div.) between them straight, and ball at S. edge encroaching in a protuberance

* The terms are occasionally interchanged by observers, the outline being sometimes referred to the enlightened, at others to the shaded part of the ring. The latter is always preferred here.

upon A: S. C(oolidge), and another. 26, *f* corner decidedly darker than *p*, at times almost black; Fig. 2: B. II. *f* much stronger and blacker than *p*; *p* projects very little; ball seems to project upon A, which is a shade darker between the two corners: B. I. Mouse-coloured shading on A from horn to horn; ball less projecting upon A; *p* shadow less dark and visible; *f* increasing every way; black: S. C.—1855, Jan. 25, a nearly black spot *in* the *p* shadow [now much smaller than *f*]: B. II, S. C. Mouse-coloured shading of Dec. 26 not now to be seen: S. C. Feb. 28, *p* shadow scarcely discernible; *f* angular on A, encroaching on Ball's div., and "giving to the outline of that part seen on ring A and division of rings the appearance of a roof with broad projecting eaves:" S. C. Corner juts over upon division (but not on rings) like eaves of a roof: B. II. March 29, *s f* limb of ball straight in front of shadow; *s* sliced off; vision not very good: S. C. Spring, shadow across B straight or concave; different observers and artists differed as to form: Secchi. Nov. 9, shadow above S. limb "much less dark on the upper and right hand portions than on the left hand:" B. II. 13, *p* shadow straight; a faint shadow *f*, (Fig. 3): S. C. 26, both shadows concave near division, *f* most so; *p* straight everywhere else, even on dusky ring; adjacent limb also straight and distorted from inferior definition: S. C. [Ball overlapping A a little: S. C. 27, on the contrary, evidently not reaching division: Lassell. This seems to be the greatest amount of opening.] Dec. 6, both concave; *f* very narrow, and not so dark as *p*, which alone is seen on dusky ring, and seems to have a penumbra along outer edge; S. limb not distorted; encroachment of ball on middle of shadows may cause apparent concavity: S. C. 6, 12, a kind of "cornering:" Lassell.—1856, Jan 8, 10, outline reversed with low powers, yet illusion suspected [much as Fig. 2, but each side equally black and blunted]; "I am quite unable to imagine any section for the bright ring (compatible with its ascertained thinness) that would give such an outline to the shadow;" 22, 23, shadow convex all round S. limb, but with 2 *ears* where it crosses Ball's div.; exact form could not be made out, but rather triangular; seen distinctly crossing division, which was much paler than shadow, brown instead of black, and from form of shadow would seem below level of rings: Jacob (Madras). Feb. 4, shadow has *not* the reversed beak, and seems to extend upon A: Secchi. 28, outline changed since Dec. 6; more regular, and a slight projection upon A, but still corners at division; *p* faint and very small; *f* plainly seen on C: B. II. March 14, trace of *p* shadow at *a*, (Fig. 5); at narrowest part, *c d*, *f* is wider than C at minor axis; its "roof" overlaps division, and is projected on A; it

slopes rapidly from *s* to *e*; "to the right the 'roof' protrudes over the shadow as it did last year; but now it overlaps both rings at *m* and *n*. The whole of this upper part of the *f* shadow is black, and darker than the rest, though the lower part is darker than the ring C, and well projected on it. Near its E. edge the shadow seems to be separated from the 'roof' by an *inlet*, *i n*, equal in depth to $\frac{1}{3}$ of *c d*, or even more." Ball does not seem to encroach upon division: S. C. [18, not at all: S. C. At greatest opening, division never seen in full breadth beyond S. limb: Dawes.] 17, roof less prominent, encroaching very slightly on A; point *r* fainter than rest of shadow: S. C. 18, roof decidedly blacker than shadow below it, but edge *m n*, till now abrupt and well-defined, seems to blend more gradually with division. *p* corner rather darker than before: S. C. 20, inlet seems rounded off on N. side; roof blacker than rest of shadow; *m n* again as sharp as ever; *p* shadow seems less prominent: S. C. 25, roof-like appearance noticed; *p* well seen: B. II. 27, limb appears straight across B, probably from its dark shade there; inlet rounded off and shadow faint at *r*; outline on B [by diagram] bent at an angle with that on dusky ring: S. C. 27, 29, De la Rue's second engraving brings *s* (Fig. 5) down to *e*, and makes *s m* a little convex; an *ear* like Fig. 2. projection on division not shown, the latter being black; shadow on B slightly concave, on C straight, and in a fresh direction; general effect, however, very similar. 31, curve of shadow expressly reversed; ring appears not plane: Secchi. April 1, never so perfectly defined before; powers to 1561; a narrow shadow over S. pole unites faint shadow *p* to black *f*; it is not the division unless refracted, because the two make an angle upon A at their junction. Roof concave to shadow near division in which it gradually disappears, without overlapping A or B; inlet rounded off, with some faint shade adhering; see Fig. 6: S. C. 2, "*l'ombre est assez curieuse, elle est renversée et ondulée;*" Fig. 4: Secchi. 4, curve reversed; a little shadow on A: ditto. 5, *p* shadow darker than division into which it blends; roof does not appear to project; is darker than rest of shadow, as black as open ansa; *f* follows regular curve of limb on B and C; inlet quite narrow, but deep as ever, and seems not rounded off: S. C. 19, shadow irregular. 25, remarkable discontinuity at division: Secchi.—1857, Jan. 1, almost exactly in opposition, no shadow visible except projecting ears crossing division, one on each side: Jacob. Jan. 13, shadow on B not black: B. II. 30, *f* shadow black, covering A except a narrow line: B. II. *p* concave and very faint; *f* black, pretty regularly curved on A, straighter on B and C; Feb. 11, *f* follows curve of ball on B and C, turns off abruptly on A: S. C. 12, faint shading *p*,

fainter than division, probably not reaching across B; *f* black, regularly curved on B and C, and not projecting at division as last year [opening of ring less]: S. C. 14, *p* very faint; *f* black, broadest at division and changing direction there, with a corner or notch, close to which division is darker: B. II. *p* seems darker and larger than Feb. 12, crossing B; *f* pretty regularly curved, a perfectly black spot in it where it meets division, not so dark elsewhere; this has the effect of breaking the curve. S. limb undistorted: S. C. Mar. 4, *p* very faint, all across B, slightly concave, and broad at division, which is plainly seen above it [and darker, in diagram]. *f* pretty uniform, but a small break at division, and 2 near apex. On this side of B "something that I cannot make out to my satisfaction. It seems as if there were a faint penumbra partly adhering to the division of rings, and partly to the shadow:" S. C. *f* black and more regular than usual; *p* a very narrow ghost-like shade, of the usual outline, all across B, broadest and darkest near division. "I was much impressed with the fact that the outline was preserved perfectly, while the intensity of the shadow was very



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feeble:" B. II. See Fig. 7. 16, *p* darker than before; *f* not perfectly regular: S. C. *p* by no means as dark as *f*, which is black: B. II. 26, *p* unaltered, *f* extends further E; its junction with division clear and sharp: S. C. Apr. 16, distortion of *f* on B suspected, but definition bad: B. II. 18, atmosphere bad, but *f* seems to be becoming concave on B again: B. II. 25, *p* distinctly visible over further half of B; *f* slightly concave on B; its breadth at division equals that of A at axis minor; at the crossing there seems a dark spot: B. II.*

Thus far extend our facts. Whall shall we say in explanation of them? Can we charge them upon personal or instrumental equation? It seems not possible, since, in the main, they are agreed upon in England, and Italy, and Malta, and India, and the United States. Some of the most singular statements, it is true, come from America alone. But as they

* Schwabe during this spring, noticed a strong convexity of the shadow on both A and B: meaning, apparently, the reversal of the outline.

have often the concurrence of more than one observer, so the optical capacity of a telescope, which in favourable air would bear distinctly a power stated to be 1561 upon Saturn, leaves small chance of appeal. In fact, it is a remarkable circumstance that the mystery of the subject has increased under closer, more powerful, and more extended scrutiny. Some of the phenomena may admit of a more or less probable solution. For instance, the apparent concavity of outline might be explained as a deception, similar to those optical perversities so ingeniously illustrated by Mr. Proctor in our August Number; and a deficiency of shadow upon A would naturally follow from its lying in a different plane. But the "ears," projecting even when the true shadow was invisible,—the two shadows when, even after allowing for the planet's latitude, one only should have been seen,—the "roof," and "inlet,"—and the varying depths of shade in different parts, are alike too clearly attested for doubt, and too incomprehensible for explanation. We might take refuge to a certain extent in the idea of varied curvatures in the shadowed surfaces; and in order to meet the objection arising from the evanescent thinness of the lateral view, we might add a speculation as to the possibility of some force emanating from the sun, which might disturb the level of the surface, in proportion as its inclination exposed it to his influence. But even after we have ventured this daring effort, we find other features as intractable as ever. Some things look like effects of an atmosphere very irregularly distributed round the ball, and possessed of properties greatly dissimilar to those of ordinary gases; but this is undiscoverable, just where it ought to be most apparent, at the concurrence of outlines very obliquely inclined to each other.

We must therefore close this subject, already protracted to a wholly unexpected length—not, however, in despair of some better solution, but as commending it earnestly to the study of those who have the means and leisure for further investigation. It was not by recoiling from apparent impossibilities that the earlier inquirers won their way to such brilliant discoveries. It was not thus that the genius of Kepler carried him forward into the unknown, or guided him in "feeling the walls of ignorance, ere yet he reached the brilliant gate of truth." Or even if disappointment in one sense should wait upon such researches, they will bring with them in another respect their own recompense: "The works of the Lord are great; sought out of all them that have pleasure therein."

The object of the foregoing papers being to bring before the student, for his own comparison, as many original data as were accessible to the writer, the following additions and corrections may be permitted for completeness sake:—

1788, Aug. 2, [illegible] suspected a little equatorial flattening.—1790. Feb. 1, ring

reappeared brightest E: Cassini.—1792, Hl had occasionally noticed very small variations in the breadth of Ball's div. and the ring itself.—1840. De-Vico saw and measured excentricity.—1841. Schwabe saw Encke's div. 5 times; July 26, Sept. 11, on both ansæ. Ball's div. almost always plainer, or broader if less sharp and dark W. Sept. 21, indistinct, with a beautiful sharp image. His observations seem in some instances to connect its greater breadth W. with larger excentricity of ring E, as though A remaining unmoved with respect to the ball, B were somewhat displaced at those times: e. g. Aug. 19, div. only distinct W.; very large dark ansa E.: 20, div. plainer E. than W.; less difference of ansæ than 19. — 1842. Sept. 2, De-Vico, Ball's more distinct W. 5, do. E. 30, Oct. 1, best W. 17, very distinct, no subdivision whatever. 25, best W.—1843. July 14, Encke's plainest E. Aug. 6, do. W. July 19, Aug. 6, 8, Ball's broadest E. July 19, 29, two subdivisions broadest E. Aug. 6, 9h. 43m. three do. plainest W.; 10h. 18m. best E. 8, three do. best E. [Is it impossible that a careful collation of the positions of the satellites, especially Titan, at any given epoch, with these features of the ring, should lead to the discovery of some connection? A friend has suggested that the closest satellite, especially, must raise a wave in A, which, however, would hardly be visible to us.] —1848. July 11, both poles brighter than equator: Bond II. Sept. 11, 12, S. belt like clouds: Schmidt.—1850. Nov. 22, Lassell suspected Encke's on both ansæ; 23, 25, Dawes do. and 29, especially *f*. Nov. 23, Secchi and others saw C brightest W., without divining its real nature; and 1851, Jan. 19, slightly broader W.—1850. Dec., when Hind first saw C, it was very narrow, and much plainer E.—1851. Oct. 26, Dec. 6, B and C not divided; 30, C broadest and most distinct W.: Secchi.—1852, Aug. 31, C fades away, so that its half next B is invisible: Tuttle. Nov., De la Rue's fig. shows shadow of A very faint on N. ball. 29, ball nearer outer edge of C, *p* than *f*, to eye; by microm. 4″·26, 5″·25, B. I. Dec. 15, div. on *p* side of B: Breen and another.—1855. Some nights in spring, Ball's broader before than behind globe; Secchi.—1856. Mar. 27, Apr. 5, 1857, Feb. 14, faint penumbra on *s f* limb: S. C.—1857. Jan. 30, do. either on S. limb or on ring in close contact: B. H.—1861. Nov. 15, blackish irregular patch on ball: Secchi.

THE FLORA OF IRELAND.*

The British Association for the Advancement of Science, at the meeting held in Bath, appointed seven gentlemen as a committee, for the purpose of investigating the distribution of the Irish Flora, with £25 at their disposal. This sum has been judiciously applied towards the publication of a work, entitled *Contributions towards a Cybele Hibernica*, under the editorship of Dr. D. Moore and Mr. A. G. More.

This royal octavo volume of 460 pages, which has just appeared, will excite some amount of interest in botanical circles, for our knowledge of Irish plants has greatly increased since the publication of Mackay's *Flora Hibernica* in 1836, and not only have many species been added, but others have become better understood, whilst the range of many has been greatly extended.

In the introduction to this work we are favoured with

* *Contributions towards a Cybele Hibernica, being Outlines of the Geographical Distribution of Plants in Ireland.* By David Moore, Ph.D., F.L.S., and Alex. Goodman More, F.L.S. Dublin, 1866. Royal 8vo., 460 pp.

some details as to the climatical condition of Ireland; the mean annual temperature of the whole island is stated to be above 50° Fahr., being about the same as that for the south of England. But this moist and equable climate, and the comparatively low range of temperature does not give rise to such a diversity of forms as occurs in a like area in Great Britain. And though the ripening of corn and fruit is later and more uncertain in Ireland than in England, and wheat often a precarious crop, yet, on the other hand, many plants thrive and flourish there which would be killed by the cold dry frost of an English winter.

We regret to find that in the work before us no attention has been given to the physical features of the island in their relation to the distribution of plants; and the reader is simply informed in a few lines of the general character of the surface of the country.

Lists are given, enumerating the species which belong to the several types of vegetation in Great Britain, thus:—

I. Of the Hibernian type, *Helianthemum guttatum, Saxifraga Geum, S. hirsuta, S. umbrosa, Erica mediterranea, E. Mackiana, Arbutus unedo, Dabeocia polifolia,* and *Pinguicula grandiflora,* ally the flora of the S.W. and W. of Ireland, to that of the West and South of Europe, and range, under an exceptional climate, to a higher northern latitude than on the continent. With these are associated *Erica ciliaris, Sibthorpia europœa, Euphorbia hyberna, Simethis bicolor, Adiantum capillus-veneris,* and *Trichomanes radicans,* which occur also in Britain.

Sipiranthes gemmipara, Sisyrhinchium anceps, Naias flexilis, and *Eriocaulon septangulare,* the latter being also British, "point to a former connection with North America."

In addition to the above-mentioned species, which occur in Ireland, but not in Great Britain, the following make up a total of 22:—*Arenaria ciliata, ? Saxifraga Andrewsii, ? S. hirta, ? S. affinis, Inula salicina, Neotinea intacta, Potamogeton longifolius, P. sparganiifolius, Carex Buxbaumii,* and *Asplenium acutum.*

II. Of the plants classed by Mr. Watson under his Atlantic type, 41 out of the 70 are also Irish.

III. Of the species belonging to the Germanic type of vegetation, 18 only out of 127 have been found wild in Ireland. The majority of these are confined to the eastern counties, but *Monotropa Hypopitys, Astragalus Hypoglottis, Teucrium scordium,* and *Bromus erectus,* occur also in the west; *Orchis pyramidalis* being distributed sparingly over a large portion of the island.

IV. The Alpine type of flora is represented by 40 species, only a little more than a third of the 113 of Watson's Highland type, most of which occur in the west and north.

"Some of the species, as *Draba incana, Dryas octopetala, Galium boreale, Arbutus uva-ursi, Sesleria cærulea, Lycopodium selaginoides,* and *Isoëtes lacustris,* occur in many places at, or a little above the sea-level, so that they cannot be termed highland species in Ireland. It is probably in consequence of the vaporous atmosphere, and the less amount of sunlight, that these plants are found at a lower level than in Scotland."

V. The northern plants, namely, those belonging to Watson's Scottish and Intermediate type, amount to 66 out of 117. Of these, *Trollius europæus, Geranium sylvaticum, Ligusticum scoticum, Melampyrum sylvaticum, Lamium intermedium, Salix nigricans, S. ambigua, S. laurina* and *Equisetum umbrosum* are confined to the north; whilst *Helianthemum canum, Potentilla fructicosa, Gentiana verna,* and *Ajuga pyramidalis* are species of the west, and *Allium scordoprasum* is met with only in Kerry and Cork.

Mr. Watson represents the flora of Great Britain as amounting to 1425 species, which has been increased, say, to 1435; of these Ireland claims about 950, to which are to be added the 22 species which occur in Ireland without reaching Great Britain, and "with the addition of *Hieraci* and *Rubi,* the whole flora may be computed at about 1000 species, thus amounting to little more than two-thirds of the plants found in Great Britain."

The authors then proceed to point out the deficiencies of the Irish flora, amongst which we notice such common British plants as:—*Genista anglica, Galium cruciatum, Helianthemum vulgare, Ranunculus hirsutus, Ononis spinosa, Plantago media, Paris quadrifolia, Valeriana dioica,* and many others of an extended latitudinal range in this country.

The island is divided into twelve districts, as shown by a map, particulars of which, such as the elevations of the highest mountains, and the more remarkable plants in each, are given. The districts are as follows:—

I. Kerry and South Cork.
II. North Cork, Waterford, South Tipperary.
III. Kilkenny, Carlow, Queen's County.
IV. Wexford and Wicklow.
V. Kildare, Dublin, Meath, Louth.
VI. Limerick, Clare, East Galway.
VII. North Tipperary, King's County, Westmeath, Longford.
VIII. West Galway, West Mayo.
IX. East Mayo, Sligo, Leitrim.

X. Fermanagh, Cavan, Monaghan, Tyrone, Armagh.
XI. Donegal and City of Londonderry.
XII. Down, Antrim, Derry.

The introduction concludes with a table, showing the distribution of the plants in the districts.

The *Contributions towards a Cybele Hibernica* present the features of a good "Local Flora." The materials are arranged somewhat after the plan of Mr. Watson's *Cybele Britannica*—whence the title. The natural system is followed; the technical and popular names of each species are given; as also the districts in which it occurs; its habitats, time of flowering, and when known, its altitudinal range; in the case of rare plants localities are enumerated.

The body of the work is interspersed with observations on the many species discarded as Irish, either because they are not considered natives, or have become extinct, or because about which no authentic information or specimen has been obtained.

There are good indices to the Latin and English names.

From a glance at pp. vi.—xv., we gather that the editors have had a paucity of material at their command, and perhaps they have experienced a reluctance on the part of authors and correspondents to avow errors of determinations. These circumstances have clearly entailed on them much field investigation.

Too much praise cannot be accorded to Dr. D. Moore and Mr. A. G. More for the successful issue of their meritorious labours. They are, however, aware of the incompleteness of this production, and appeal to the botanists of Ireland "to assist them in the preparation of a more complete work," adding that "there is an ample field yet open in the exploration of the flora of their native country."

One interesting branch of study is recommended—"The upper and lower limits of the elevation of plants," regarding which, it is very properly observed, "that little is gained by the statement, that a species descends to sea-level in *one* district, while it ascends to 3000 feet in *another;* it is only by comparing both upper and lower limits in each different range of hills, or at least in each of the chief groups, that any useful results can be expected."

Cybele, as employed by Watson to express the distribution of plants upon the earth's surface, and adopted in the present work, is somewhat misapplied. The volume "is merely a revised list of the wild plants of Ireland, with a classified summary of their localities;" it deals in no generalizations, and is inferior in many particulars to some of our good Local Floras.

The association of plants with certain kinds of soil is not even alluded to, although the way has been led by Mr. Foote,* who has shown that in "The Burren," county Clare, as in most districts, there is a close connection between botany and geological strata; and Mr. Tate† has pointed out the peculiar attachment of many species in the north of Ireland to certain rocks and soils. As the *Cybele* is but the sum of all the local floras, so we may reasonably expect that facts of this kind should have been collated, and some general law have been deduced.

If some regard had been paid to this department of the *Cybele*, the parcelling out of the island into districts would have been made more in accordance with the physical and petrographical features of the surface than has been done. Such an investigation has led the writer to differ from the authors who attach the county Down to the counties of Derry and Antrim to form their District 12. Now, geologically, Down is very differently constituted from Derry and Antrim; in the former palæozoic rocks prevail, yielding light and warm, and, in a few localities, calcareous soils; whereas the basaltic rocks occupy the greater portion of the surface of Derry and Antrim, with keuper marls and liassic shales beneath the escarpments of the volcanic masses. The soil of this area is cold and heavy, excepting here and there along the coast, where sand and gravel are met with, in which case a marked group of plants accompany the same. Much of the district is, moreover, elevated above the agral zone, and is greatly encumbered with wet peat bogs; in the county Down, this is not much the case, and the surface is varied by the occurrence of swamps.

In the *Cybele* I find that 112 species are recorded in the counties Antrim and Derry, which are unknown in Down, and that 25 species met with in that county are wanting in Derry and Antrim; the number of species in common being about 650. This partial incommunity of species between Down and Antrim is real, and cannot be reasoned away on the grounds that the latter county has been better worked; it is due to physical features, soil, and geographical position. For it is significant that the county Down is richer in species of the Germanic and English types of vegetation, whilst Antrim and Derry contain a superior number of Scottish and Highland plants; some of which, however, though eminently characteristic of the northern counties, pass into Down, and *vice versa*. As, for example, *Lamium intermedium* (the frequency of the occurrence of this plant appears unknown to the editors), which occurs from Magilligan, county Derry, along the coast

* *On the Distribution of Plants in Burren.* Trans. Roy. Ir. Acad. 1852.

† *Flora Belfastiensis.* 1863.

line to Belfast, and inland at Bellaghy, county Derry, is met with on the light sandy soils of the county Down, in the immediate vicinity of Belfast, but extends as far south as Newtonards.

The incongruity of including Down in District 12 is manifest; it should—at the very least, its southern half—form part of District 5; or, with a portion of Antrim, and with Armagh and Louth, constitute an additional district.

It appears objectionable to separate the S.W. shore of Lough Neagh from District 12; the basin of the lough, and the area drained by the Lower Bann constitute a natural district; and if it be impracticable to unattach it, the whole of it should certainly form part of District 12. By this arrangement, such a restricted plant as *Calamagrostis stricta* would belong to one district, as it naturally does, and not to two, as now.

The *Cybele Hibernica* is remarkably deficient in generalizations; there is no comparison with neighbouring floras, and no allusion is even made to the late Prof. Forbes's *Origin of the Flora of Ireland*. This certainly is a disappointment, inasmuch as doubt had been raised as to the correctness of Forbes's premises, whereon he established that masterly essay on the sources whence the flora of Ireland, as well as of Great Britain, was derived; and it is not unreasonable to suppose, considering the care the editors of the *Cybele* have bestowed on the thorough investigation of the plants that have come under their notice, that they are in a position to test the soundness of Prof. Forbes's conclusions.

Another edition will be required, if the workers, which this publication will undoubtedly raise up, will respond to the solicitations of the authors, who repeatedly direct the reader's attention to the paucity of species in Districts 7 and 11. The labours of the writer during a few weeks of the summer of this year, have added *Medicago sativa*, *Helminthia echioides*, and *Myriophyllum alterniflorum* to the list of District 12, and have furnished new localities of species thought to be rare. He offers the following few remarks by way of addenda and corrigenda:—

Is *Ranunculus pseudo-fluitans* not merely a state of *R. peltatus?* The two grow in the Bann, at Coleraine; the former in the rapids, and therefore without floating leaves; the latter in still water, where floating leaves are developed.

It is stated that "the two sub-species, *Fumaria pallidiflora* and *F. confusa* have not been sufficiently distinguished, but appear to be about equally distributed." The latter is generally distributed in Antrim and Derry, but always on light soils; the latter is rare, and has occurred to me at the Curran of

Larne, Carnlough, Cushendall, and Toome Bridge; all the localities in Antrim.

Lavatera arborea occurs in many stations on the east coast of Antrim, always by houses, and has no claim, in District 12, to rank as a native.

Geranium pratense grows at Dunluce and Port Ballintrae, and not *G. sylvaticum*, as suspected in the *Cybele*.

Myriophyllum alterniflorum is common in Antrim. *M. spicatum* is rare.

Arctium intermedium is a common plant on the Antrim coast; *A. minus* was not seen.

Orobanche rubra is not confined to the basalt in District 12. It was gathered on White Limestone, at Ballintoy, and at Ballyvoy, near Ballycastle.

Helminthia echioides grows wild on Island Magee, District 12.

Calamagrostis stricta, confined to the shores of, and islands of Lough Neagh, was discovered in profusion on the shores of Lough Beg, county Derry.

There is no value in retaining localities whence species have long since been eradicated, and where there is no possibility of their reappearance; preserve the record, but do not confuse collectors by the insertion of erroneous references. In the volume before us are too many examples of this kind, which, we presume, have been inserted through ignorance of the present unfitness of the locality for the growth of the species. *Typha angustifolia* does *not now* grow near Belfast. The ditch near the Belfast Linen Hall, where, in the last century, *Lemna gibba* grew, has many years been filled up.

In several instances the locality of a species appears under two or three names. This is decidedly objectionable, for not only is the bulk of the volume increased, but an erroneous impression as to the frequency of its occurrence is produced. Thus, the locality for *Rosa Hibernica*—"hedges on the shore near Holywood, Belfast Harbour"—postively includes "hedge-rows half way between Holywood and Belfast" of one, and "Hedge, Tillysburn" of another author.

Despite the aid rendered by two eminent London botanists in the revision of the proof-sheets, there are very numerous errors, both of omission and commission, in the volume.

R. T.

CHACORNAC ON COMETS.

THE following is a translation of a paper for which we are indebted to M. Chacornac. It forms part of the *Recherches d'Astronomie Physique*, which he issues from time to time:—

"Since the great comet of 1811, it has been known that the nuclei of comets as they approach the sun dilate into vaporous atmospheres, to a certain limit, uniformly round the nuclei, since if that limit is passed, these atmospheres are compelled, by the action of an unknown force, to flow back on a level surface, in the prolongation of the *radius vector*, with a velocity nearly equal to that of light.

"In seeking to interpret this grand phenomenon of nature with the aid of simple physical laws, we are led to the following conclusions. If no repulsive force emanated from the sun, and opposed their dilatation, these cometary atmospheres would extend in all directions, at least as far from the nucleus as the extreme length of the tails, since the dilatation of a gas in a vacuum appears to be indefinite. The rapidity with which these atmospheres are developed is such, that even at a temperature such as that of the earth's surface, it would be considerable.

"The aigrette of the comet of 1862 extended through a length equal to four times the diameter of the earth in an inappreciable time, since the first trace of this jet, though weak, was observed throughout the whole extent the moment it was perceived. This fact shows that the expansive force of the gaseous matter is great enough to produce effects like those repulsions which arise from elevation of temperature, and we are naturally led to conceive of similar actions in the solar photosphere.

"If we consider what must occur at the limits of the pressure of the exterior atmosphere, where the force of gaseous expansion exceeds the attraction of the solar mass, it would seem that the gaseous matter heated by the photosphere would overflow into the vacuum of space. The behaviour of the sun's external atmosphere appears in perfect accordance with this consequence of the physical causes in operation. Thus above the purple zone (*zone pourprée*), which appears contiguous to the photosphere during total eclipses, a zone of dense atmosphere is constantly noticed which reflects a brilliant light, and on this account has frequently been confounded with the reappearance of the disk on its emersion. It is from the external surface of this atmosphere that those rays of the solar aureole spring, the configuration of which indicates the expansive force of gases projected violently into planetary space.

"If we calculate the velocity of outflow with which a gas precipitates itself into a vacuum, we find that at the pressure of our atmosphere, and at a temperature of zero, it is greater than that of a cannon-ball; and, in fine, it is demonstrated that the pressure is insignificant in determining the velocity of the flow of different gases, which depends on their density only, and is greater as the density is less.*

"If these considerations are applied to the question of the limitation of planetary atmospheres, it will be seen that it is possible that at the temperature of planetary space there may be an equilibrium between the weight of the external atmospheric layers and the elasticity of those below them, but this cannot be the case with a vaporous atmosphere exposed to a temperature of many thousand degrees. Moreover, for an external layer to press inwards from its weight, we must conceive that it can no longer dilate itself in the vacuum of planetary space, that is to say, it must be more dense than what is beyond it. This last consideration affords mathematical ground for regarding the external layer as *crystalline*,† in order to comprehend how any atmosphere—like that of the earth—can be limited.

"At the surface of the sun such an hypothesis is not admissible, and, moreover, in the phenomenon of re-incandescence, seen in the photosphere, there must evidently be a repulsive force acting upon gases, and producing violent dilatation according to laws which are not known. We do not know what forces of dilatation would be developed at such enormous temperatures, but it is incontestable that the radiating aureoles of the sun point to a projective force acting outwards, and shooting forth perpendicularly to the solar periphery masses like innumerable and very dilated aigrettes of comets."

M. Chacornac appends sketches of aigrettes formed by the comet of 1862.

* "Et enfin ou demontre que la pression est insignifiante pour la vitesse d'écoulement des différents gaz, que celle-ci est dependante de le densité des gaz seulement, puis-ce-qu'elle est autant plus grande que la densité est moindre."

† We have before had occasion to notice the peculiar sense in which M. Chacornac uses the words crystal and crystalline. We must either suppose the elasticity of the atmosphere to be limited, or we must imagine such an arrangement of its particles as to give rise to, or be acted upon by, opposing forces. Why this should be called a crystalline state we do not see.

A STRANGE PLACE FOR ROTIFERS.

BY HENRY J. SLACK, F.G.S.,

One of the Hon. Secs. of the Microscopical Society of London.

In the writer's garden hangs a Mason's hygrometer, or wet and dry bulb thermometer. The supply of water to keep the wet bulb moist is held in a small glass vessel about one inch in diameter, and rather more than that in height, and having a short neck, just wide enough to allow some threads of lamp cotton to hang freely through it. It may therefore be described as a small glass, squat bottle, loosely stoppered with lamp cotton. Every two or three days in warm dry weather, and every two or three weeks in wet weather, this vessel requires replenishing, which is usually done by holding it under a tap, and suffering the stream not only to fill, but to give a good washing to the cotton and to the vessel. When the cotton is dirty it is removed, and fresh supplied. No green matter of any kind has grown in the vessel, and very little atmospheric dust could find access to it. Under these circumstances it could not be expected to be a favourable place for any kind of infusoria, but in August the cotton fibres became slimy without getting discoloured, and this circumstance led to a microscopic examination. There was no decay in the cotton fibres, and very little extraneous matter adhering to them, but the slimy matter resulted from the presence of a considerable number of infusoria, among which were many rotifers of small size and of the common sort.

The chief infusoria in point of numbers were monads of minute dimensions, some swimming freely with a jerking motion, and others jumping violently without much change of place. With the help of Smith and Beck's one-twentieth and first eyepiece, giving a magnification of 1000 linear, it was seen that these little objects were provided with single tails or filaments, and were able to adhere to the glass by the extremities of these organs, and being thus moored fast to a fixed point, they executed a series of jerking jumps in all directions, with great liveliness. The body of these little monads was white and pear-shaped, about 1—8000″ in greatest diameter, and more or less filled with smaller cells. The tails or filaments were exceedingly fine, and four or five times the length of the bodies. A few small ciliated infusoria were also present. The rotifers were numerous and very lively, though apparently stunted in growth by the limited supply of food.

Part of the cotton was transferred to a Preston salts bottle filled with cistern water, and left uncovered, so as to catch

floating dust. The consequence was that in a week or two much more organic matter was present than had been in the hygrometer vessel, but this did not lead to increase in the rotifers, which on the contrary decreased, although some new animalcules (trachelius, etc.), made their appearance, and one very delicate round, empty test—probably of a difflugia—was observed. This was curious on account of its being covered with what appeared to be microscopic crystals of carbonate of lime.

As it cannot be supposed that clean undecayed fibres of cotton were devoured as food by any members of the colony, they must all have lived on the very minute quantity of other organic matter present, and either in decomposition or growth. The monads were probably vegetable, though possibly animal. They appeared to form the food of the rotifers, and had nothing noticeable to live upon.

This accidental experiment affords an illustration of the fact that very minute quantities of organic matter in decay are sufficient to lay the foundation of, and for a time support, a numerous infusorial colony, which may include objects of comparatively high organization. The wind may have carried small rotifers, or their eggs, on to the cotton; or, which is more likely, one may have been imported in the cistern water with which the hygrometer vessel was filled; and, notwithstanding the limited supply of food, the creature and its progeny flourished for many weeks.

FAMILY LIFE OF THE MIDDLE CLASS.

The good qualities of the English middle class, as developed in their family life, are amply recognized; indeed, an exaggerated estimate of them too often occasions a blindness to very striking, if not perilous, defects. The term "middle class" usually designates those families whose income is, wholly or chiefly, derived from personal exertion in trade, commerce, or a so-called "learned profession," and this description will be sufficient for the purpose of this paper. The family income in this great section of the community may be supposed to range from two or three hundred to as many thousands a year; but there are many whose resources are smaller, and others who are able to rival and exceed the expenditure of the wealthiest houses of the aristocracy. Social custom divides the middle class into several grades, partly on the ground of diversity of wealth, and still more on that of occupation. As a rule, retail trades are held to be inferior to those that are wholesale, and it is thought to be "genteel" to sell goods in a warehouse, and comparatively "vulgar" to sell them in a shop. The greatness of London tends to swamp many minor distinctions, and hence the popular estimate of the dignity or inferiority of occupations has less action in the metropolis than in smaller towns. The fashionable world rigidly excludes from its private assemblies all who are known to be guilty of the serious offence of dispensing articles in small quantities. Mr. Jones, who sells cotton in the bale, is admissible; Mr. Thompson, who will accommodate his customers with a skein, could not possibly be tolerated. This exclusion of retailers is more or less broken into when the shop is in the city, and the family reside in a villa a few miles off.

In small towns the artificial distinction of social grades has more rigidity and completeness. One or two successful professional men are allowed to visit "county families," and the same high powers will sometimes look benignly upon a local merchant, if his transactions are large. In such towns it frequently happens that the most intelligent and useful man for rendering service in public questions, local or national, keeps a shop, and he is thus placed in an awkward intermediate state. His talents and services compel a certain amount of consideration from those above him; but as they cannot condone the shopkeeping, they do not freely admit his family into their circles, and probably those of his own precise rank are not sufficiently cultivated to be his natural companions. In many little towns social visiting is well nigh impracticable, except amongst relations, as every man in the

place is a little too high, or a little too low, to be socially civil to anybody else.

In country towns there are other peculiarities, as, for example, the position assigned to manufacturers, which is chiefly, though not entirely, dependant upon the style in which they live. The great manufacturer ranks as an important man in the county as well as in the town, while the smaller maker of the same article is held in little estimation. This is also noticed in such businesses as brewing. Those upon whom the vats and coppers have, in Johnsonian phraseology, conferred "a potentiality of becoming rich beyond the dreams of avarice," are freely welcomed by great landed, or noble families, while those whose vats and coppers are of smaller dimensions would be snubbed if they attempted any intercourse of the kind. In agricultural districts the precise position of farmers' daughters is often difficult to settle, and we remember serious conflicts of opinion in a little town, as to whether certain young ladies of this description might be invited to public balls. The general opinion of the young men was in favour of the girls, whose beauty was admired; but the puzzle was how to admit them without their brothers, who were voted too rough.

It is not our purpose to inquire into the complicated rights and wrongs of these social divisions; but their existence materially affects the conditions of middle-class family life. They make the co-operation of large bodies of the middle class very difficult, and they tend to prevent the best manners and the wisest opinions from spreading throughout the mass.

As a rule the education of middle-class families is bad; on the whole that of the richer sections, though still bad, is the best, while that of the poorer sections is not equal to that which the working class enjoy in the *best conducted* British or National schools. All through, there is a deplorable want of any species of culture that tends to enlarge the mind. Physical science is woefully neglected; political economy and social sciences usually ignored, though remarkably well taught, as part of the instruction supplied for sixpence a week, in the famous Peckham School, founded by Mr. Ellis, and conducted by Mr. Shields. Only the dry bones of geography are usually imparted in the shape of names of places and rivers, with their latitudes and longitudes, and history figures as a dull catalogue of battles and dates. Very rarely does any school-teaching develop a capacity for enjoying or understanding the great literature of our own or any other country, and many a boy is cured for life of any fancy for poetry, by its being made an instrument of torture in Latin or Greek.

It would not be fair to the schools if we were to forget that

their profit depends upon their supplying what their customers demand, and until the heads of families entertain more worthy ideas on the subject of education, or are willing to be led by those whose judgment is enlightened, it will only be in rare cases that a schoolmaster or mistress can get a living by doing justice to the pupils. At the present moment there are many schools in advance of the average requirements of their supporters, and the best schoolmasters evince a laudable anxiety to improve the system of instruction. We must also recollect that it is very hard work for a schoolmaster to be continually engaged in pulling his pupils upwards, if the family life to which they are periodically remitted pulls them down again.

The composition, habits, and education of middle-class families leads to a general deficiency in taste for intellectual pursuits. It is the exception, not the rule, even for a single member of the family to have a decided taste for science, literature, or art, or to cultivate it so as to reach any considerable degree of proficiency or knowledge. Taking the whole of our middle class, with its vast numbers, it is, of course, easy to select some thousands of persons to whom these remarks do not apply; but they are unfortunately applicable to the great majority of those who are rich, as well as of those who are comparatively poor. The number of families in which any member has attempted to make a study of Shakspeare, Milton, or Bacon, is—relatively—very small; and still smaller the number of those who systematically study, for pleasure, a science or an art. One conspicuous proof of this may be found in the absence of demand for lectures of a high class, and in the small number of copies of first-rate books that any publisher can sell. Many excellent works are with difficulty pushed through a sale of five hundred copies, and few first-class books reach a sale of a thousand copies, except after years of recognition, and strenuous efforts on the part of the bookseller. Rubbishing books, on the contrary, often enjoy a large immediate sale.

The ordinary middle-class family is not much given to the purchase of books. If somewhat feeble in intellect, it will have its Tupper; if stronger, its Longfellow or Tennyson: but what thousands of homes in which the upholstery is excellent, the comestibles costly, and the grand piano unexceptionable, both for cabinet work and tone, in which not a readable book is to be found in secular literature, and in which, if any question arises on points of history, science, or art, it is in vain to appeal to the "library" for a reply! England is, in this respect, far behind the New England States of America. The close of a school career leaves "young ladies and gentlemen" as euphuism always describes them—boys

and girls, as we prefer—at an age when help to continue old studies, or enter upon new ones, is peculiarly desirable; and, as a rule, nothing of the kind is provided. Some years ago, in the metropolis, there were in full activity, the Royal Institution, the London Institution, the City of London in Aldersgate Street, the Mechanics in Southampton Buildings, and some others, which were thronged by the members of middle-class families, who attended considerable courses of lectures on important subjects by eminent men. Classes were also common for the further pursuit of the same branches of knowledge. Now, the Royal is in full vigour, the London in genteel decay, the Mechanics in doleful dirt, and others have disappeared. Only the Royal Institution in London, and less than half a dozen other institutions in the three kingdoms, can attract an audience for a course of first-class lectures on any subject whatever. Eight hundred or a thousand institutions exist throughout the country, of which many neither have lectures nor form classes; while nearly all in which lectures figure confine them to subjects that are trivial, or to graver ones treated in the most useless and flimsy way.

Even in London, if any family of more than common intellectual ambition would like its boys and girls, when their school time has passed, to acquire a reasonable knowledge of any physical science, or to get help in the more difficult branches of literary or artistic study, they are not encouraged by facilities, but staggered by difficulties. A district in which five or ten thousand families of moderate means live, ought to be able to co-operate and provide the necessary machinery of lectures, classes, and libraries; but nothing of the kind is done. The social demarcations to which we have adverted, no doubt, constitute a serious difficulty, but the chief obstacle is the absence of desire.

Much drudgery falls upon many members of the middle class, but in cases where pecuniary means are sufficient to preclude the necessity for over-toil, the dignity that should belong to home-life is damaged by idleness and frivolity. In too many cases, if the young men are not in business, they may be found in the billiard-room of a public house; and if the girls are not required for household duties, their hours are passed in the idle gossip of morning calls, or evening parties. Thousands of families, which do not fall into these special errors, set up for their standard, propriety, not excellence; and if they escape the blame of doing mischief, they are still open to censure, as they contribute nothing to the active forces by which society is prevented from running to decay.

Young men, prematurely emancipated from parental authority, usually take to their own courses, while girls, perhaps of finer tastes and more sense, are subjected to too

much control. A possibility of isolation at fitting times, liberty in the choice of pursuits, facilities for gratifying them—these are requisites for the best development of girls. If their home-life is always passed in the common sitting-room of the family, if at years of discretion they cannot buy a book, obtain an instrument, and take a walk to look at a picture, or pick a flower, without interference and supervision, their characters are dwarfed, and their faculties have no fair play. The "fast young lady" may be an unpleasant symptom of social disorder, but the tame young lady is a more hopeless product of social disease.

The want of tastes is a serious family evil, as well as an individual fault. A life without excitement is impossible for many, and objectionable for all. Good honest tastes form the springs of useful exertion, and in the endeavour to gratify them a wholesome excitement is to be found. Exclude the tastes for good things, and tastes for bad things will spring up; because some human faculties will be active, and if the finer elements of our nature are enfeebled by want of exercise, lower propensities and passions are left in sway. There are painfully respectable natures, incapable of any but cheap virtues, and without the vigour needful for great defects; but they are not objects to be contemplated with any approval. There should be something heroic and dignified in every life, and no human being should be permitted to grow up without throbs of aspiration towards that which is noble, beautiful, and true.

Tastes for good things are, in the higher natures, so strong as to command their means of cultivation, even under adverse conditions; but in ordinary mortals they must be cultivated, or they will never exist. Even in childhood, the family atmosphere, or the influence of some special person, determines for the major part of mankind whether they shall grow up with or without strong tastes for something useful and elevating. If circumstances hinder, or fail to favour, such cultivation and growth in early years, it becomes exceedingly difficult or impracticable afterwards. Parents often wonder why the young man of sixteen or eighteen is headstrong and dissipated, when the seeds of such conduct and character were sown in his childhood, through the inaptitude of the family life to stimulate a higher sense of duty, or cultivate a taste for worthier pursuits.

Family life presupposes the daily meeting of the same persons, often with a very moderate allowance of intercourse with outsiders. The male part of a quiet family, through their occupations, usually get most change, while the women suffer, like greenhouse plants under a bad gardener, who keeps the doors and windows shut. Even frivolity of admixture with other fellow-creatures is better than the damp, mildewy influence of isolation, with nothing elevating to do. But a family

ought to contain within itself no small share of the elements of happiness and growth; and with anything like proper education and cultivation, it would be difficult to find three or four people, even of the same parentage, without a wholesome diversity of character and tastes. If the various members of a family have their own occupations and pursuits, some from the necessities of business, others from the promptings of choice, and each does his own work well, the meeting together will neither be tame nor tiresome, nor will the only bond that keeps them together be a notion of duty, or a mere instinct of affection.

There can be no greater contrast than exists between two sections or orders of middle-class families—the larger one, in which there are no particular tastes or pursuits of a high character; and the smaller one, in which they exist in force. To the smaller category, public events, and social movements, scientific discoveries, the labours of art, the appearance of noteworthy books, supplies daily food of an intellectual and exciting kind, upon which each comments with earnestness and intelligence. In the larger class, the mental food is scarce or bad, the mental appetite languid, and the digestion weak. The women, as the weaker vessels (and brought up to be so), accept the situation as they find it, while the young men too often seek in dissipation for an excitement which domestic emptiness does not afford.

"—— Winds blow and waters roll,
Strength to the brave."

So says Wordsworth. And if our middle-class families can summon up courage enough to assail the evils we have pointed out, they will find abundant help from the cultivated minds within their own ranks. Let us endeavour to sketch a few of the changes to be desired. In the first place, every member of a family ought to be able to read aloud either prose or verse sufficiently well for the performance to be intelligible and pleasurable, while in many instances a considerable degree of artistic skill should be attained. This demands practice in acquiring power over the voice, accurate and critical knowledge of the thing to be read, and such aid as can be obtained through hearing really good (not clap-trap) professional performers. Each family ought to be able, with certainty of response, to address one or more of its members, and invite him or her to

"Lend to the rhyme of the poet
The beauty of thy voice."

It is exceedingly difficult for any one to appreciate the blank verse of Shakspeare, with its wonderfully-varied rhythm, or the grand, though less flexible, verse of Milton, without hearing it well read; and the same remark may be made of the finest prose passages, such as those which abound in Bacon,

Jeremy Taylor, or Sir Thomas Brown. The foundation of a fine taste in literature is often laid by good reading, and good family reading does not require the acting style in which certain favourite public performers over-indulge. Boys as well as girls ought to learn music, if they have any aptitude for it, otherwise the time so spent is wasted; but whoever pretends to learn music should not be satisfied with playing or singing the fashionable pieces of the day. Some knowledge of music as a science should be acquired. This involves a little thorough bass, and a little accoustics; and music should further be studied as a fine art, and some notion obtained of the peculiarities of the leading schools of the great composers, and the methods by which their effects were produced. If music is worth learning at all, it should, like all other things, be learned properly, whether the study be elementary, or carried to a great extent. Drawing and painting should be studied on the same broad principle, whether the time devoted to them be more or less. A study of drawing and painting would be useful to thousands who could never be proficient in either art. It assists the comprehension of what great artists have accomplished; and those who have paid no attention to perspective, colour, and shadow, have not learnt to see. The beauty of form, and its idealization, will be brought within the mental grasp of those who have learnt how to look at a fine figure-piece, while the landscape artists (and especially Turner) will teach those who study them how to enjoy the aspects of nature in all the gorgeous subtleties of atmosphere and light.

Some elements of science, such as physics, chemistry, geology, and astronomy, should be deemed essentials in any system of education, and also the rudiments of physiology and natural history.

No family that can afford the money ought to consider its house furnished if it does not contain a telescope and a microscope, neither of which need be very expensive for general purposes; and there should be a fair collection of books, for reference on all the leading topics likely to interest rational persons living in a civilized country. Diversities of taste would make some tend more to art, some more to science, and some more to literature; and, although certain elementary information on a variety of topics ought to be communicated to all, it would be a grave mistake to endeavour to force all to pursue the same career of study without regard to difference of mental constitution. Let us suppose a family of half a dozen persons. It is most probable that all will like, at times, to be well read to, and most, if not all, will enjoy the good music that those most proficient in that art can give at leisure intervals. If one has a fancy for observational astronomy, all are sure to

like to take a frequent glance at solar spots, lunar mountains, and double stars, if accompanied by such explanations as will enable them to understand what they are looking at. If another works with a microscope, all will be glad to see any new object of remarkable beauty or curiosity, provided its nature is explained. A geologist can always interest ordinary mortals, if they are not in a state of preternatural stupidity, by showing and explaining appropriate objects; and so can a botanist, or any other student of special matter. Each member of a family should be expected to contribute something to its intellectual life, as well as to its moral excellence, and no child should be brought up to be an uninteresting and mentally unprofitable member of the circle. Lectures ought to be made systematically available for what they are worth; they can never replace class teaching or private study, but they are admirable introductions and stimulants, and useful for keeping up knowledge already gained, and bringing it up to date.

In addition to such larger combinations as may be necessary for the support of public institutions, why should not a few families combine for the general encouragement of intelligent pursuits. With mutual help, the study of difficult subjects might be facilitated, and very interesting gatherings might advantageously replace many dolefully stupid and sorely afflicting parties, in which nobody has anything useful or entertaining to say.

We do not want to flatter our readers, but we do look upon them, and upon those like them, who *ought* to be our readers, as the leaven that is to leaven the lump. Progress takes place when superior minds, or better cultivated minds, come into frictional contact with, and excite less advanced minds. It is for families who have learned to rejoice in the fulfilment of those intellectual duties which devolve upon human beings endowed with noble faculties, and placed in a noble universe for their exercise, to lead others in the same path. Let them exclaim, with Wordsworth—

> "———— What we have loved,
> Others will love, and we will teach them how;
> Instruct them how the mind of man becomes
> A thousand times more beautiful than the earth
> On which he dwells: above this frame of things
> (Which, 'mid all revolution in the hopes
> And fears of men, doth still remain unchanged)
> In beauty exalted, as it is itself,
> Of quality and fabric more divine."*

* This grand passage, which forms the conclusion of the *Prelude*, is a *pons asinorum*, or donkey's bridge, for bad readers, who are sure to break down before getting through it. We recommend families to have a try at it, each member at a time, and the one who can bring out its full sense and majestic rhythm, will deserve at least as much credit as the boy or girl who gets over the famous proposition of Euclid, to which we have likened it.

THE STONE AGE IN CHINA.

BY M. CHEVREUL.

The following paper is translated from *Comptes Rendus*, 13th August, 1866 :—

"It is now the custom to designate by the expression 'age of stone' those pre-historic times when men, not acquainted with metals and the methods of working them, fashioned out of hard stones implements such as hammers, chisels, knives, hatchets, etc. A passage from the life of Confucius, by Père Amiot, printed at Paris in 1788, shows that the Chinese passed through the stone age.

"Confucius, so states his biographer, being in the kingdom of Tchen, stayed at the house of a sage named Tcheng-Tsee, when the king of Tchen perceived on the terrace of his garden a bird of prey which seemed to have *three wings*, and a strange mode of flight. The king ordered that the bird should not be lost sight of, and should be brought to him alive or dead. The bird soon fell lifeless on the steps before his palace. The bird had only two wings, but the feathering of an arrow that transfixed its body explained how it appeared to have three; and the extraordinary fact was that the arrow, quite different from those then in use, was armed with a hard-pointed stone instead of with iron, and its wood was peculiar. Tcheng-Tsee, the friend of Confucius, was commanded by the king to explain the matter, but being unable to do so, he spoke of Confucius as one capable of fulfilling his majesty's desire. Confucius, having recognised the bird as a *sun*, a kind of hawk, whose peculiarity it is not to chase the birds it feeds upon, at their love season, or when they are incubating, said, 'This kind of bird of prey is a native of the land of Sou-chin, to the north of Tartary; it never comes to our climate. Inasmuch as the arrow is armed with a piece of hard stone instead of an iron point, it resembles that which Ou-ouang presented to the prince in whose favour he erected into a kingdom the country of Tchen, when, having extinguished the dynasty of Chang, he gave the fiefs to his chief assistants in that glorious expedition. This arrow was thirteen inches long, without reckoning its stone armature, and was given as the sign of sovereignty of him who was created King of Tchen. Seek, Sire, in your armouries, and perhaps, in spite of the different revolutions which have happened since the creation of your kingdom, the arrow may still be preserved. If it can be found, let us compare it with that which has occasioned the death of this bird, and we may conclude from it that heaven favours your majesty,

since it allows the authentic sign of the sovereignty of the kingdom to fall into your hands.'

"The text adds that the king caused search to be made amongst his antiquities, and that an arrow was found precisely similar to that in the bird of prey.

"Does it not appear from this passage that at the succession of Ou-ouang to the empire, the date assigned to which is 1122 B.C., iron-pointed arrows were used, but that tradition preserved the reminiscence of sharp, stone-pointed arrows, and that Ou-ouang availed himself of this tradition, and gave a sacred sanction to the kingdom of Tchen by an imperial gift of a weapon used by the ancient Chinese?"

To this paper of M. Chevreul is appended a note by M. Stanislas Julien on the "Age of Stone in China." He quotes the dictionary *P'ing-tsen-loui-pien*, printed in 1726, to the effect that stone arrows were found in digging the earth in the district Sin-thou-hien, where in old time there was a tower and a camp. In the *Annals of Song* (biography of Tchang-sun), soldiers are spoken of as fighting with stone arrows. These annals were composed under the Youen dynasty, which lasted from 1260 to 1341. The *Annals of Northern China*, composed under the Thang dynasty, founded in 1618, states that 'in the country east of Fo-ni all the arrows have iron points.' In another passage in *P'ing-tsen-loui-pien*, arrows are spoken of 'pointed with bluish-black stone.'

"The Chinese have a particular character, *nou*, signifying a stone, from which arrow-points are made (*Dic. du P. B. de Glémona*).

"We read in *Koue-yu* (a Discouse on Kingdoms), a work anterior to our era, this passage, relating to the kingdom of Lou, the land of Confucius, 'When Confucius was in the kingdom of Tchin, a hawk rested on the palace of Prince Tchin, and was killed (or died?) there. It was pierced with a stone arrow-point fixed to the wood of Khou. This arrow was twenty inches long. Hoei-kong, Prince of Tchin, ordered a man to carry the hawk to Confucius, and inquire of him concerning it. The philosopher said, this hawk comes from afar. The arrow which has killed him is an arrow of the country of So-tchin.'

"In *P'ing-tsen-loui-pien*, vol. xlii., fol. 38, we read, 'In days of yore Wou-wang (who mounted the throne in 1122) having conquered the dynasty of Chang, opened a way in the midst of the country of nine barbarous tribes, and ordered them to bring tribute of the produce of their land. Then the inhabitants of the country of So-tchin offered arrows made of the wood of Khou, and pointed with stone. These arrows were twenty inches long.'"

"I omit other passages of the same kind. In the *Annals of the Dynasty of Thang*, founded in 1618, I find mention of stone hatchets; and in other passages a stone knife, a stone sword, and a stone agricultural implement for stirring the soil are spoken of."

OBSCURATIONS OF THE SUN.

BY M. ED. ROCHE.

THE following paper appears in *Comptes Rendus* for 27th August, 1866:—

"The term obscuration has been applied to transitory diminutions of solar light not connected with eclipses by the moon. Historians have recorded several phenomena of this kind; and Humboldt notices a certain number in *Cosmos*, doubtless selecting those which seemed to him the most important and the best established. He admits, without hesitation, that at certain epochs the disk of the sun was momentarily obscured, and the light so weakened, that stars were visible in daytime. Arago, in his *Astronomy*, has reproduced the same assertion. An obscuration of the sun, therefore, is analogous to a total eclipse, but longer in duration, and resulting from abnormal conditions.

"Having had occasion to examine the texts cited by Humboldt, I perceived the necessity for rectifying the interpretation of several, which have led me to very different conclusions. The greater part of these phenomena of obscurations were veritable eclipses, badly observed, or inaccurately described. Thus, to cite only one example, the obscuration which took place on the 28th February, 1206, is nothing else than the eclipse of the sun of 28th February, 1207, seen in Spain, France, and Italy; and if certain historians of the time referred it to 1206, this was because the year then commenced on the 25th March, and not on the 1st January.

"Except at the periods of eclipses due to the interposition of the moon, the sun has never diminished in splendour, so as to produce a kind of night, and allow the stars to appear. The small number of authentic cases in which stars seem to have been visible in full day, lose their marvellous character when subjected to a searching examination. These pretended apparitions of stars are usually thus reduced to some planet which was visible in the daytime during an obscuration.

"One of the most remarkable of these facts is that of

April, 1547. According to a tradition reproduced by Kepler from a passage of the *Cosmo-Critico* of Cornelius Gemma, the sun was so enfeebled for three days, that the stars appeared. In a note on this subject (*Comptes Rendus*, t. lx., p. 653), M. Faye has shown the unlikelihood of such a phenomena. Nevertheless, the recital of Kepler rests on something real, and by research amongst contemporary witnesses, the explanation is discovered. There was certainly, about the 24th April, 1547, the day of the battle of Muhlberg, an obscuration—that is to say, a mist of fog obscuring the sun and the moon, according to Gemma Frisius.* As for the appearance of stars, Cornelius Gemma does not say that he or his father saw them, which would have given his assertion great value. He appears to have borrowed the statement from *De Meteoris*, of Frytsch, of Lanbach, who first mentioned it.

"According to Frytsch, it was on the 12th April that the stars were seen, and it was exactly on this day that the planet Venus was at her maximum of illumination, and up to the end of the month she remained under conditions favourable to her being seen in full day. The unusual appearance of Venus, close to the time of the obscuration which occurred a few days later, seems to have been the veritable foundation of the story, which Kepler accepted the more readily, as it tended to confirm his theories.

"I have studied various phenomena of obscuration, and a comparative view of them leads us to refer them to a particular state of the atmosphere, known as a *dry fog*. The origin of these fogs is quite uncertain. They are commonly ascribed to volcanic exhalations, and they may likewise be due to meteoric dust suspended in the air, and diminishing its transparency. But, whatever may be their cause, the connection between them and the obscurations is not doubtful; and to explain the latter we need not have recourse to gratuitous hypotheses, such as perturbations in the photosphere, occultations of the sun by a cosmical mass, or by a cloud of asteroids."

* Reinier Gemma, the father of Cornelius, so called from his birth-place, Friesland.

ARCHÆOLOGIA.

THE Kent Archæological Society has issued the sixth volume of its collection of papers, published under the title of *Archæologia Cantiana*, the contents of which do great credit to the management of the Society. The most remarkable of these is Mr. Brent's account of the researches in the early ANGLO-SAXON CEMETERY AT SARR. Mr. Brent has already opened a hundred and eighty-three graves in this cemetery, and we believe that much still remains to do. The very numerous objects found in these graves present a singular and almost perfect picture of Anglo-Saxon life. We have the arms of the warrior sufficiently complete, the ornaments of his personal attire, and especially the various ornaments of the person of the Anglo-Saxon lady, and the articles of her toilette. We have the characteristic pottery and glass which loaded the Saxon festive-board, and the various domestic implements of the household, the money the Saxon spent, and even the dice with which he gambled. The contents of one of the graves were very remarkable—it was that of a man. Near the feet, and about two feet three inches from the surface, was a small black earthern vessel; on the left side lay the umbo of a shield, and near it, all together, as if the contents of a bag or purse which had undergone decay, about fifty small circular counters of bone or ivory, one or two apparently made of the teeth of an animal. A sword, thirty-seven inches long; a spear-head eight inches and a quarter, and the ferule of the shaft; a small brass coin of the Emperor Magnentius; some rivets, a knife, an iron ring, and a small bronze buckle, were also taken from this grave. All these objects are characteristic of the pagan Saxon gentleman, and it may be remarked that he seems to have placed his implements of gambling under the protection of his shield. Such draughts or counters have been found in several instances in Saxon graves. They vary a little in size and shape; but they are all circular and flat-bottomed, and some nearly conical, while others are but slightly convex. A pattern of little double circles, with a dot in the centre, appears on the upper side of most of them. Some of them had decayed, and it was judged that the original number had been about sixty. In a grave opened subsequently, a second set of similar counters was found, the number of which was about forty, and there were with them two dice, which leave no doubt of the use of the counters.

The contents of another of these graves were equally interesting, the more so, as similar objects have been found in other Anglo-Saxon cemeteries. Near the skull of the occupant of the grave lay the umbo of a shield, and on the left side a spear. On the breast a fine buckle, brightly plated, and what appeared to be the mounting of a purse. On the left side were some iron keys, and an iron lock, with a bronze plate containing a hole for its lock, no doubt the remains of a box. At the left foot lay a small BALANCE AND SCALES, WITH NINETEEN WEIGHTS. The other contents of the grave were a knife or dirk, with a smaller knife in one doubled sheath of wood,

a circular iron plate, another knife, and a pair of shears. In the case above alluded to, the Saxon had been a warrior; in this he was evidently a dealer in some articles which required weighing, as well as cutting and dividing. The beam of the balance was about five inches long, and slightly chased; the end of the thread or silk which suspended the scales remained still adhering to its end, and some of it was found attached to the scales, which were an inch and seven-eights in diameter. The weights, in number about twenty, were formed of Roman coins, rubbed to the exact quantity, and most of them were marked by dots, which seemed to indicate a multiple of weight. The lock had a bolt made to ascend diagonally into the bronze plate, which was rather more than six inches long, and one and a quarter wide, and was very like such a plate on our own door-posts. The double sheath with two knives, an object which has never been found in an Anglo-Saxon grave before, presented the exact type of the Highland *scian*, or dirk and knife in a double scabbard. The whole of these discoveries are of a very remarkable character, and furnish a satisfactory evidence of the utility of our local archæological societies.

Among some ROMAN INSCRIPTIONS recently found at MESVE in France, there is one of peculiar interest, as giving us the name of a goddess previously unknown, Clutonda—no doubt a local divinity, but as proving that the village of Mesve, on the right bank of the Loire, is the site of the *Masava* of the Romans indicated in the Peutingerian table. The inscription, which is read as follows, informs us that one Medius Acer, the son of Medius Annus, gave to the statue of Masava "a wall between two arches, with its ornaments:" *Augusto sacrum, deæ Clutondæ et Vicanis Masavensibus: Medius Acer, Medii Anni filius, murum inter duos arcus, cum suis ornamentis, de suo dono dedit.*

A few days ago, at SUTTON HILL, in Corve Dale, Salop, some excavations were made which, though as yet of little extent, are of some interest. It may be remarked that Sutton Hill—which is the property of Charles Powell, Esq., a gentleman who has for some half a century held the office of Chairman of the Board of Magistrates—is composed of limestone rock, with a rather shallow covering of earth. A part of the summit is uncultivated, and has been long quarried for the purpose of obtaining stone for making lime; and, in the course of this process of quarrying, many human skeletons, according to the information given by the labourers, have been found at different times, and with them objects of various kinds, some of them of iron. The accounts of these former discoveries are so circumstantial and apparently truthful, that they cannot reasonably be doubted, although all the objects discovered have long been dispersed, and no sufficiently scientific account of the discoveries has been preserved. In the earlier part of the present month, at the suggestion of Mr. T. Wright, an attempt at more careful exploration was made, under his immediate direction, which resulted in the discovery of a skeleton, laid on its back, with the head to the west and the feet to the east, and of some of the bones of a second skeleton, apparently a secondary interment, at a slight

elevation above the other; but the inclemency of the weather prevented the continuation of the excavations for the present. No objects of any kind were found to help us to fix the people or date to which these interments belong; but there can be no doubt that they were of very great antiquity; and they probably still remain undisturbed over some part of the top of the hill, which has never been quarried. The occurrence of implements made of iron would lead us to suppose that this was an early ANGLO-SAXON CEMETERY, in which case, it would be the first discovery of Anglo-Saxons found on the Welsh border; and, as the Mercians (Angles) and the West-Saxons met and appear to have overlapped each other in this district, the objects found with the bones would perhaps enable us to decide which of those two divisions of the Teutonic settlers in our island first established itself in South Shropshire. The graves appear to have been cut into the decomposed and soft upper part of the rock, in the same manner as, in Kent, they are dug into the chalk.

Further explorations have been made among the SEPULCHRAL TUMULI on the YORKSHIRE WOLDS, some account of which has been given in the contemporary papers. From these descriptions, which do not appear to us to be entirely satisfactory, it appears that the objects found consisted of human skeletons, of broken pottery, and of flint flakes, and presumed flint implements, with nothing to suggest any decided opinion as to their date. The tumuli opened were three in number, situated on the Sherburn wolds, near Scarborough. In each of them, bones were found, thrown together very confusedly, and independent of the entire skeletons; and it is assumed, we think rather unnecessarily, that these are the results of the practice of cannibalism among the race who are buried in these tumuli. It must not be forgotten, that all these tumuli are described as having been much crushed and broken down by the process of tillage, and that the bones may therefore have been, at some former period, dug up accidentally, and reinterred in this confused manner.

T. W.

LITERARY NOTICES.

CHARLES WATERTON: HIS HOME, HABITS, AND HANDYWORK. Reminiscences of an Intimate and most Confiding Personal Association for Thirty Years. By RICHARD HOBSON, M.D., Cantab., Leeds. With Sixteen Illustrations. (Whittaker & Co.)—Dr. Hobson has produced a very pleasant, rambling, but readable collection of reminiscences of Charles Waterton, and of his famous residence, Walton Hall, a large mansion, built on an island in a great pond, or lake, in which all kinds of water-fowl found a happy, undisturbed home, while land creatures were equally cared for and protected in the adjacent park. The house was full of stuffed specimens, exemplifying its owner's remarkable skill as a taxidermist, and justifying, according to the general opinion of those who were

fortunate enough to see the collection, the peculiar methods which Mr. Waterton adopted. Mr. Waterton belonged to a class of eccentric characters, found more often in out-of-the-way country places than in towns. When, as was the case with him, these singular specimens of humanity are remarkable for benevolence as well as for intelligence, no one has a right to criticise their peculiarities harshly. The manners and modes of thought of our age tend too much to destroy individuality, and we ought to be thankful that a few persons stand out from the monotonous ranks, winning respect for their substantial goodness, and reminding us that humanity in a civilized country need not be reduced to a series of mechanical imitations of a few favourite types. Doubtless Mr. Waterton would have been a greater naturalist and a greater man if something like a crack or craze had not run through his character, but his life was a useful and valuable one, and he had the great and rare merit of being true to himself. With great physical courage, and that sort of moral courage which enabled him to pursue his own course in defiance of what Mrs. Grundy, and even more rational authorities might think expedient, he was nevertheless in bondage all his life to superstitious ideas, and he had not the slightest notion of the way in which free political and religious systems contributed to human advancement. His mind was mediæval rather than modern, and new processes and improvements in agriculture seem to have been viewed by him as heresies to be avoided rather than as practices to be pursued. His body he called his "ass," and he took care that it should never be pampered. An old suit of clothes, a "shocking bad hat," with ventilating apertures worn in its crown, and a plentiful coat of dirt adhering to its surface, formed his regular costume. He slept on a board, with a log for a pillow, and a rough wrapper for a covering. When very ill, he would, under medical orders, betake himself to a sofa, but a bed he would not enter, as he considered that would be indulging the body more than was necessary for good health. Ordinary visitors were rigidly excluded from his domains, but he would admit large parties to occasional picnics in his park; and if persuaded that any one really wanted information on natural history or taxidermy, he was happy to afford it, on condition of the recipient's repaying his teacher with an abundance of reverence and faith. He was rigid in all the fasts which the Roman Catholic Church ordained, and his favourite remedy for any kind of illness was copious bleeding from the arm. That he should have survived this treatment to extreme old age is a proof of the wonderful strength of his constitution, and, indeed, in all physical matters he was an extraordinary man.

"Mr. Waterton," says Dr. Hobson, "during his long life, never partook of either wine, spirit, or malt liquor. In addition to simple water, a cup of excessively weak black tea was his favourite, indeed his only, beverage, on all occasions, into which he put a large quantity of sugar, but no cream." He went to bed about nine o'clock, and rose at half-past three, when he lighted his own fire, which had been laid for him the previous evening, and began some

natural history work. Great benevolence, not restricted by conditions of creed, and a habit of incessant Latin quotation (in which his friend, Dr. Hobson, participates), and a strong perception of humour, were other characteristics of the "old squire;" and it is no wonder that he should have conciliated much affection while living, and that his friends should delight to honour his memory now that he is dead.

Many of the stories told by Dr. Hobson are highly amusing, including the famous rattlesnake scene at the doctor's house. An assembly of professional friends was arranged to try the comparative effects on rabbits of the rattlesnake bite, and the wourali poison which Mr. Waterton obtained in South America. An American showman, with a collection of the dangerous reptiles in glass cases, was invited to the party, and Mr. Waterton astonished them all by the boldness with which he put his hand into the cases and caught any snake that was wanted by the neck. One of the reptiles nearly escaped; the doctors fled pell-mell and helter-skelter down stairs, some rushed hastily into the street and did not return, but Dr. Hobson pressed the lid of the case door so as to obstruct the complete exit of the snake, and Mr. Waterton quietly took hold of it and remitted it to its prison. Mr. Bartlett of the Zoological Gardens, and Dr. Günther of the British Museum, handle venomous snakes with equal confidence and impunity; but Mr. Waterton's performance caused him to be looked upon as little less than a conjuror by those who were not acquainted with the character of reptiles, and the circumstances under which they may be safely seized.

The Waltonian mode of stuffing animals consisted in soaking the skins in a solution of corrosive sublimate, and moulding them from within before they dried to the exact form of the living object. A few mechanical supports were used while the skins dried, and they retained their shape for ever after.

On Force: Its Mental and Moral Correllates; and on that which is supposed to underlie all Phenomena with Speculation and Spiritualism, and other Abnormal Conditions of Mind. By Charles Bray, Author of the "Philosophy of Necessity," the "Education of the Feelings," etc. (Longmans.)—Mr. Bray commences his work by reviving the proposal to dispense with the belief in matter, and confine our credence to "centres of force." The objection to such a proposal is that we cannot get on without the idea of matter, however incomplete, and possibly incorrect that idea may be. The one term centre of force will not carry us far, either in the description of phenomena or in reasoning upon them. Let us take one of Mr. Bray's sentences and see if we can make it fit his philosophy. He says, "It is a limited quantity of force that is derived from the food, and the mode of its action depends upon its distribution over the body . . . . . while digestion is going on the powers of thinking and feeling are proportionably increased." Are we to say it is a limited quantity of force which a man derives from eating centres of force for breakfast. While he is digesting centres of force, his powers of thinking and feeling, themselves consisting of other centres of force, are proportionably decreased, and so forth? Most persons will

find it difficult to conceive of a force without its resulting from some substance in action; and whether the term spiritual or physical is applied to a force, it is equally supposed to be the effect of a something acting, and not a self-existent entity. With many of Mr. Bray's speculations we agree, but we think he sometimes fails to see the bearing of his own words. For example, he says, "As all actions are the necessary result of pre-existent force, they are *morally* alike in themselves—right and wrong, virtue and vice, having no existence but as they affect the well-being of the sentient creation." The introduction of the word *morally* is surely a mistake. All actions may be alike, in that they are the results of pre-existent forces, but the morality of an action involves questions of obligation, duty, etc., and hence the moral likeness of a set of actions will depend upon circumstances quite distinct from the physical cause of the actions themselves. Again, Mr. Bray says, "Truth, justice, and wisdom are only relations to *finite* things, and cannot therefore be infinite, or absolute in their own nature." Surely if these be infinite things, there may be truth, justice, and wisdom concerning them. Infinite truth would be truth concerning all existing or possible things. A particular truth relating to a particular thing, has no claim to be called infinite, and this may be all that Mr. Bray intends. Mr. Bray quotes with approbation Bentham's dictum, that an immoral action results from a miscalculation of self-interest; but, with great admiration for Bentham, we must agree with those who think his notions of moral philosophy defective. It is possible to make the term "self-interest" comprehend a devoted promotion of the interest of others; but by such an enlargement of the scope of the term we destroy its special meaning, and leave it like an algebraic symbol, the significance of which is determined by its position. Man has self-regardant faculties, and extra regardant faculties, and it tends to confusion to designate the happiness which springs from self-sacrifice by the same term as that which denotes self-seeking. We do not see that Mr. Bray in anywise proves his assertions that "there is nothing underlying phenomena—phenomena are correlatives of force, and force is all." After having demolished matter, Mr. Bray still finds his *force* as "one infinite substance," "force changing into life, and life into sentience," etc., and he endeavours to explain what are called "spiritual phenomena," as resulting from modifications of mental force. For those who are fond of metaphysical speculations—carried often into the regions of the unknown, Mr. Bray's new work will provide ample suggestions, but before undertaking to reduce the so-called "spiritual phenomena" to some sort of cohesion with general philosophy, we must learn exactly what phenomena really occur in table-turning, spirit-rapping, etc., etc. Under all ordinary circumstances no obstacle is placed in the way of applying physical science tests and methods to alleged physical effects, but the spiritualists demand faith at the wrong end, and their tables will not rap, and their sideboards will not walk across the room, if sceptical persons with experimental modes of verification or disproof happen to be present. Mrs. De Morgan's recent book, written in

manifest honesty, shows, as other works have shown, that an anti-scientific believing frame of mind is essential to what is called spiritualistic success.

Tape Worms; Human Entozoa: Their Sources, Nature, and Treatment. By T. Spencer Cobbold, M.D., F.R.S., Lecturer at Middlesex Hospital. (Longmans.)—We suppose Mr. Cobbold hopes to tempt readers by this little volume to study his large work on Entozoa. We should not have thought it worth while to publish the present small treatise, which is little more than a portion of the larger work.

Electricity. By Robert M. Ferguson, Ph.D., of the Edinburgh Institution. (Chambers.)—This volume, which forms part of "Chambers' Educational Course," is a compact and well arranged treatise on the subject indicated by its title. Magnetism, Frictional Electricity, Galvanism, Electro-dynamics, Electro-magnetism, Magnetic Electricity, Thermo-Electricity, and Practical Applications of Current Electricity, are treated of in separate chapters, and praiseworthy pains seem to have been taken to bring the whole fairly down to date.

A Dictionary of Science, Literature, and Art. Comprehending the Definitions and Derivations of Terms in General Use, together with the History and Descriptions of the Scientific Principles of nearly every branch of Human Knowledge. Edited by the late W. T. Brande, D.C.L., F.R.S.L. and E., of Her Majesty's Mint, and the Rev. George William Cox, M.A., late Scholar of Trinity Coll., Camb. Part X. (Longmans.)—The present number, finishing "Radient Heat," and progressing as far as "Rules," contains many excellent papers supplying the information most likely to be needed by those who resort to a Cyclopædia.

The Anthropological Review. Journal of the Anthropological Society, and Popular Magazine of Anthropology, Part XIV. (July, 1866). (Trübner.)—Contains some interesting papers; and though we should, in a detailed review, repeat some of our old objections, we think this magazine is improving, and it certainly deserves credit for calling popular attention to a highly important and neglected class of subjects.

Date Stones; or, Mnemonics of General and Constitutional History and of Literature. By Newenham Travers, B.A., formerly scholar of Lincoln College, Oxford. London.—This book, small in dimensions but important in contents, is published by the Author at his own residence, 25, Tolmers Square, N.W.; we suppose he has not published it in the usual way because he has especially designed it to assist in a short series of lessons of which we find a notice accompanying the book. Mr. Travers is well known to hundreds of young men educated at University College School, in which he was for many years a remarkably able teacher. The subject matter of his "Date Stones" is well selected, both for general students and for those who desire to pass examinations for the civil service or for university certificates. The mnemonic plan is substantially the same as that employed by Dr. Grey, but worked out with much originality. Mr. Travers dissents from Dr. Pick's

view that real words should always be employed, but in his artificially compounded words he preserves a suggestive portion of the name of the person or incident to be remembered. At the close of each chapter are some hexameter verses, in which the chief incidents with their several dates are mnemonically epitomized, and though, like all similar combinations, they look as if they would distress the jaws that utter them, we cannot doubt their utility after many proofs that have reached us that Mr. Travers' pupils really do use them with success.

Wayside Flora; or, Gleanings from Rock and Field towards Rome. By Nona Bellairs, Author of "Hardy Ferns," "Going Abroad," etc. (Smith, Elder and Co.)—The inexorable requirements of society compelled Miss Nona Bellairs to go to Rome, and being fond of wild flowers, she provided herself with the necessary apparatus for collecting and drying them. She enjoyed her trip, and describes it in a pretty volume, giving the names of some of the flowers that took her fancy, and of the pictures and buildings that pleased her eye. A good-tempered reviewer—and those who are admitted to our columns are all of that happy character—does not know what to say of books of this kind. There is not enough in them for especial praise, or description, and yet it would be hard to blame them because they do not reach some ideal standard of which their author's never dreamt. Miss Bellairs certainly merits commendation for having a taste and a purpose, and her books, though slight, may help other young ladies to acquire similar good things.

The Handbook of the Stars; containing the places of 1500 Stars, from the first to the fifth magnitude inclusive, upwards of 200 of which are noted as Double, Multiple, or Variable: a list of Star Names; a Table for determining the position of the Constellations on the celestial concave at all hours and seasons; and other Useful Tables. With an examination of the properties and projections used in mapping, and hints on the selection, use, and construction of Star-Maps. By Richard A. Proctor, B.A., F.R.A.S., late Scholar of St. John's College, Cambridge, and King's College, London. Illustrated by maps and diagrams. (Longmans.)—The voluminous title of this little book amounts to a catalogue of its chief contents, and, from the merit of Mr. Proctor's previous works, the scientific public will be prepared to receive this with favour. Some of the chief topics have been recently discussed in our pages, so that all we need say now is, that the explanations of star maps and their principles will be found compendious and valuable. The sixth of the tables supplied by Mr. Proctor strikes us as particularly useful. It is easily understood, and gives by simple inspection the names of the constellations occupying the zenith, and other parts of the heavens, at any hour for any day of the year. As a guide to a knowledge of the constellations, and to their changes in position, according to the time of the year, this book will be found remarkably useful. The list of double-stars, though not going below the fifth magnitude, will also be of service. In a few instances, we think, an error has been made in giving their distances. Thus, the

components of Castor are put down as between two and three seconds apart, while Engelmann's measure gives 5″526; δ Herculis and *comes* are given as between seven and eight seconds apart, which is surely much too little.

ELEMENTARY TREATISE ON PHYSICS, EXPERIMENTAL AND APPLIED. For the use of Colleges and Schools. Translated and Edited from *Ganot's Eléments de Physique* (with the author's sanction), by E. ATKINSON, Ph.D., F.C.S., Professor of Experimental Science, Royal Military College, Sandhurst. Second edition, revised and enlarged. Illustrated by a coloured plate, and nearly 700 woodcuts. (Ballière). Part II.—In a notice of the first part of the new edition of this excellent work we expressed a decided opinion that it is the best book of the kind which has appeared. To that opinion we adhere, though there are some minor points in which Professor Atkinson ought to have improved upon the original. Thus, at p. 447 we are told that the new silvered glass mirror telescopes "are much shorter than the old ones, their focal distance being only about six times the diameter of the mirror." The celebrated Short made his 'dumpy' metallic telescopes with focal lengths as short as have been given to any successful glass ones, and it is incorrect to say that the usual focal length of fine glass silvered telescopes is only six times the diameter of the mirror. The figure given of the mounting (p. 448), though pretty looking, is bad—very inferior to Mr. Browning's pattern, and students will be misled who suppose from M. Ganot's work that a 6½ inch mirror should only bear a magnification of 150 to 200. One of that size in our possession, the mirror by With, and the mounting by Browning, bears from 600 to 700 well on bright objects. The microscope in this part fares worse than the telescope. Instead of figuring a good instrument by one of the great English makers, a very poor one by Chevallier is represented, giving no idea of the best constructions, and nothing is said concerning the formula of the best objectives. These, however, are trifles in comparison to the general merit of the work, but they ought not to be passed over.

THE BIRDS OF MIDDLESEX; a Contribution to the Natural History of the County. By JAMES EDMUND HASTING, F.Z.S. (Van Voorst.) —A very pleasantly written work, giving accounts of the birds habitually living in, or visiting Middlesex. Mr. Hasting has judiciously left technical descriptions and systematic information to be obtained from well-known ornithological works. His remarks are thrown under heads corresponding with the principal divisions of birds into orders and families, and frequently enlivened by good anecdotes. For example, a very interesting account is given of a black-backed gull, caught and tamed by the author:—"A curious fact with regard to this gull is that he catches sparrows for himself very dexterously, and the way in which he does it is this. About the time that the fowls are being fed, he makes his way to the poultry-yard, and mingling with the hens, walks very slowly about with his head drawn in so as to make his neck look very short, and as if, in fact, he were trying to look as much like a fowl as possible. As soon as the general rush for grain is over, the sparrows drop

down one by one, and then it is that the gull, drawing gradually within reach, suddenly darts out his long neck, and seizes an unfortunate sparrow by the head. So rapidly is this done, that escape for the unsuspecting sparrow is hopeless, and in another second he is crushed and devoured." On one occasion this same bird seized a young kitten, which the cat had brought out on the lawn, and tried to swallow it whole. He was discovered with the kitten's head down his throat, making frantic efforts to swallow the body, and was greatly disappointed when the little creature was rescued by one of the family. This book is illustrated by musical notations of the song of many of the birds, and by a frontispiece in a deplorable style of art. A very tolerable engraving of Kingsbury Reservoir is quite spoilt by printing a dingy rhubarb tint all over it!

PROGRESS OF INVENTION.

IMPROVEMENT OF THE HYPSOMETER.—The boiling points of fluids depend on the pressure of the air. The greater the altitude of any place above the ordinary level of the earth's surface, the lower the boiling point of a given fluid, because the less the barometric pressure in that place. And hence the height of any place may be found by means of the boiling point of water in that place. With this object a peculiar kind of thermometer, termed a *hypsometer*, or more correctly, a *hypso-thermometer*, has been constructed. It is marked, not with degrees of temperature, but with barometric pressure corresponding to these degrees, or, better still, according to the latest improvements of M. Abaddie, with the altitudes corresponding to the temperatures, supposing them to be the boiling points of water. The boiling point of a fluid can be accurately determined by placing the thermometer in the escaping vapour; but unfortunately the results are liable to vitiation, on account of the tendency which the zero of thermometers almost invariably has to alter spontaneously. The danger of error from this cause is, however, greatly diminished, if two or three hypsometers are used in each experiment, and the mean of their indications is taken. The hypsometer is, for several reasons, more suitable for the purposes of travellers than the barometer. It is more easily carried, it is less easily injured; and it requires, not an observation, but an experiment which is made with greater facility, and is less subject to error.

MAGNESIUM AND ITS SALTS AS ILLUMINATING AGENTS.—The complication necessary when the magnesium wire is fed by means of clockwork, has been hitherto a great obstacle to the use of the magnesium lamp for the purposes of illumination or photography. This difficulty has, however, been obviated by the lamp exhibited in operation at the recent meeting of the British Association at Nottingham. The magnesium passes down in the form of a very fine powder from a reservoir, through two small tubes, the lower aper-

tures of which are placed opposite to, and at a small distance from, each other. To dilute the magnesium powder, and thus render the feed more gradual, and the light more diffused, it is mixed with fine sand before being placed in the reservoir. And to prevent the tubes through which the mixture of sand and magnesium issues from being choked with magnesia, on account of combustion of the magnesium taking place within them, coal gas is transmitted through them with the mixture, and burns along with the magnesia. Finally, to remove the small quantity of magnesia which, forming at the aperture of the tubes, might ultimately stop them up, the sand, after separating from the magnesium during the combustion of the latter, falls into a small receiver; and this, tilting over every few minutes, on account of the weight of the sand, gives motion to a wire to which are attached nippers that seize the magnesia and separate it from the tubes. When the sand has fallen out of the receiver, it again assumes its ordinary position. The cost of this lamp is, however, very considerable. The amount of coal-gas used with it is, indeed, very trifling, but the magnesium is very expensive, and will probably continue so. This very serious objection is likely to be got rid of by the use of the oxide of magnesium, which M. Carlevaris, of Geneva, has found to answer, in conjunction with the oxy-hydrogen flame, as well as the metal itself. Oxide of magnesium is in this case volatilized, though to a very small extent; but this minute quantity of vapour imparts a pure white light that may be used either for ordinary illumination or for photography, having all the properties of solar light. The effect is due to oxide of spongy magnesium, and this may be conveniently produced from several of the magnesium salts, especially from chloride of magnesium or carbonate of magnesia. For this purpose a small piece of chloride, for example, is placed on a prism of gas-retort graphite, and the flame of the burning gases is thrown upon it. The use of pure oxygen is not indispensable; common air and hydrogen answer extremely well. Also, the chloride, after having been compressed into the form of a prism or cylinder, may be merely introduced into the flame, no graphite being employed.

Prevention of the Spark produced by the extra Current.—In electro-magnetic experiments, the oxidation caused by the sparks due to extra currents, is highly inconvenient, as it prevents perfect metallic contact, and thus greatly diminishes the electro-magnetic effect. There are two kinds of *extra* current. One of them is opposite in direction to the battery current, and is produced when connection with the battery is established. It is perceptible chiefly by its neutralization to a greater or less extent of the battery current. The other, which is in the same direction as the battery current, is produced when connection with the battery is interrupted. It retards the demagnetization of the electro-magnet, and causes oxidation so as to prevent perfect metallic contact between the different portions of the conductor. The latter evil is prevented by a very simple means, due to Dr. Dugardin, of Lille. He provides a separate conductor for the extra current. For this purpose he permanently connects the poles of the electro-magnet

with a small helix of wire, which, however, offers so little resistance to the ordinary galvanic current, on account of its low intensity, as to divert but a very small amount of it from the helix belonging to the electro-magnet. Were the wire of the resistance coil, thus introduced, of any considerable length, the effect produced upon it by induction would be very mischievous. But its resisting power is derived, not from its length, but from the material of which it is formed. This being a very thin wire of iron, or, better still, of maillechort, an alloy of zinc and cobalt. A helix containing only one metre of the latter will produce as much resistance as many kilometres of telegraphic wire, and thus the interposed helix may, for the largest electro-magnet, be extremely minute.

PHOSPHORUS A METAL: THE SO-CALLED AMORPHOUS PHOSPHORUS CAPABLE OF CRYSTALLIZATION.—Certain properties of phosphorus lead to the conclusion that it is a metal very similar to the other metals arsenic, antimony, and bismuth, belonging to the group in which it is found: but the supposition is strongly confirmed by recent experiments, in which the property possessed by lead of dissolving phosphorus is applied to the production of phosphorus in the crystalline form. The phosphorus is put, along with the lead, into a thick tube of hard glass, the interior of which is next exhausted of air, and hermetically sealed. The glass tube is then placed in an iron tube, capable of being closed at the ends; and the space between the tubes is filled with magnesia, after which the apparatus is kept at a high temperature for eight or ten hours. On cooling, the surface of the lead is found covered with crystals of phosphorus, which, like those of arsenic, antimony, and bismuth, are rhombohedric. They have a metallic appearance, and are black by reflected, but red by transmitted light. Their specific gravity is greater than that of the ordinary and even of the amorphous phosphorus, being 2·34, while that of the others is 1·82 and 2·14. The volatilities of these three different kinds of phosphorus differ in a similar way.

The so-called amorphous or red phosphorus can now be easily crystallized. For this purpose, M. Blondlot, who discovered the fact, draws out the neck of a matrass in a lamp until it is about the size of a quill. He then fuses phosphorus under water in glass tubes capable of passing through the contracted neck, and introduces two grammes of the cylinder thus obtained into the matrass, having previously wiped them with filtering paper: after which he hermetically seals its neck, keeping it during the process wrapped in a moist cloth to prevent the phosphorus from igniting. It will, however, emit light while combining with oxygen, and this combination will be complete in twenty-four hours, after which its temperature is to be raised to that of fusion, solar light being excluded by covering the matrass with a truncated cone formed of cardboard. After a few hours, brilliant points will make their appearance in the upper part of the matrass, and after two or three days crystalline arborisations will have covered its whole surface. The crystals thus formed are cubes, sometimes octohedrons, and sometimes in the form of long projecting needles. As long as they are kept from light they are colourless, but even diffused daylight

changes them very quickly to red, without, however, diminishing their brilliancy or transparency. That, in becoming red, the phosphorus has not changed its properties is evident from the fact that if heat is again applied, it will be covered with the white crystals. The latter, as might be expected from the eminently electro-positive properties of the phosphorus, rival the diamond in brilliancy.

Simplification of the Soda Manufacture.—Sulphide of sodium is, in the ordinary process of manufacture, changed into sulphate of soda, by means of nitrate of soda, which involves considerable expense. It has been found, however, that the oxidation of the sulphide may be effected by far less costly means. For this purpose it is only necessary to utilize the oxygen of the air, which is effected in the following way:—The crude liquor is placed in a vessel with a false bottom, having a great number of small holes. Into the centre of this false bottom has been inserted a pipe, the upper end of which projects over the top of the vessel, and terminates above by a funnel-shaped throat. Steam of about forty pounds pressure being made to issue from a jet, which is situated a little above the throat, in rushing into the funnel it carries along with it a large quantity of air: and this issuing through the holes of the false-bottom, and passing into the fluid in a finely-divided state, so as to come in contact with a very large surface, all the oxidisable matters present are oxidized, and thus a considerable quantity of sulphite is changed into sulphate in a very short time. The manufacture of alkalies is carried on at present on so vast a scale that any improvement of the processes used in it must be productive of an immense saving.

Improvement of Glass for Optical Purposes.—Great refractive power is the chief desideratum in glass for optical purposes. This is obtained by means of great density, which hitherto has been due to lead. It has been found, however, that replacing the potash or lead, and especially the former, with thallium, affords a highly refractive glass of the finest description. 300 parts sand, 200 parts peroxide of lead, and 335 parts carbonate of thallium give a glass which has a greater specific gravity and a higher refracting power than any other known, its specific gravity being 4·235, and its index of refraction for the yellow rays, 1·71. It is perfectly homogeneous, and has a slight yellow shade which is very pleasing. It may, perhaps, be found useful to makers of artificial gems. A much greater specific gravity and higher refractive power may be attained by altering the relative amounts of the ingredients.

New Electric Alarm.—An electric alarm of extreme delicacy, the invention of M. Robert Houdin, is formed by soldering together a blade of copper and another of steel, fixing one end of this compound blade to a board, along which it lies parallel, something after the manner of a knife used in chopping, but not in contact, that friction may be avoided. Near the free extremity of the blade is a metallic knob, which is capable of being moved to different distances from it, and is in conducting communication with one pole of a galvanic battery, the free end of the compound blade being in connection with the other. When the temperature of the surrounding air is increased, the compound blade becomes curved,

on account of the metals of which it consists being unequally expanded; and coming in contact with the metallic knob, battery connection is completed. This causes a small bell, similar to that used to attract the attention of the attendants in telegraph offices to ring; and thus notice is given of any undue rise of temperature in the place containing the instrument. Information of fire having broken out may thus be obtained, and the necessary means for its extinction may, in consequence, be promptly taken. The temperature at which the bell will ring may be regulated by adjusting the metallic knob: and the apparatus is so sensitive that a lighted cigar or taper placed within a very few inches of it will cause the bell to ring.

Thermo-electric Properties of Iron.—The small quantity of carbon which causes the difference between malleable and cast iron produces so considerable a modification of thermo-electric properties, that, while a thermo-electric battery of malleable iron and bronze causes the needle of the galvanometer to be deflected to the left, a similar battery of cast iron and bronze causes a deflection to the right. The discovery of this curious fact led M. Arnould Thenard to make experiments with a battery consisting of malleable and of cast iron; and the results he obtained indicated other anomalies which could scarcely have been anticipated. Thus, with a battery consisting of malleable iron and bronze, the deflection was found to be + 23°, and with a battery of cast iron and bronze —11° 5; and it might be supposed that with a battery of malleable and cast iron the deflection would be 23 + 11°·5 = 34°·5. Such, however, was not found to be the case; the deflection actually produced being only 27°. The electro-motive force of the three kinds of battery was in accordance with what might be expected: that of malleable iron and bronze, cast iron and bronze, and malleable iron and bronze being represented respectively by the numbers 691, 263, and 953: the last being very nearly the sum of the other two taken together.

Oxygen obtained from Atmospheric Air.—Our ordinary modes of obtaining oxygen for experimental and other purposes are very costly or very troublesome. It may, however, be procured with great facility through the medium of permanganate of soda, which, as it may be used over and over again, for the purpose, will entail but a trifling expense. Atmospheric air is passed over a solution of the permanganate, which, after a while, becomes saturated with the oxygen it has absorbed, the nitrogen having passed off. To separate the oxygen from the solution, a current of vapour at a proper temperature is substituted for the current of air, this, almost without producing any change in the permanganate solution, further than dilution, causes the oxygen to be evolved. Concentrating the solution by heat renders it again fit for use, especially if a very small quantity of the permanganate is added to it.

Miscellaneous.—*Substitute for Amalgamated Zinc in the Galvanic Battery.*—M. Zaliwski-Mikorski has recently informed the Academy of Sciences that if the zinc of a galvanic battery, instead of being amalgamated, is moistened all over with oil, or even with ether, or any of the liquid hydro-carbons, the duration of the current

is greatly increased.——*New Textile Fibre.*—If, as soon as its flowers have been gathered, the stalks of the hop-plant are made into bundles, and well steeped in water, then dried in the sun, and beaten like hemp, a fibre will be obtained which, after being combed, is admirably adapted to being spun into thread, that furnished by the larger stalks being well suited for cordage or twine. This is very important as the flower is not in any way interfered with.——*New Application of Cork.*—Springs of India-rubber, used in the buffers of railway carriages, etc., under the influence of great pressure soon lose their elasticity. Cork, which may be of an inferior kind, has been found an excellent substitute for them. To render it soft and permanently moist, it is soaked in a mixture of molasses and water. It is then cut into discs which have a central hole, and are placed in a cylindrical cast-iron box, and over them a flat iron disc. Being then subjected to great hydraulic pressure, their thickness is reduced to one half, after which a bolt is run down through the metallic and cork discs, and the bottom of the cylindrical box, and is fastened by a nut. This, when the pressure is removed, prevents the cork from regaining its original dimensions. The apparatus is now ready for use. Cork discs about eight inches in diameter are found to exhibit extraordinary elasticity under a pressure of 20,000 lbs.

NOTES AND MEMORANDA.

Chemical Poisoning.—M. Melsens states, in *Comptes Rendus*, that chlorate of potash and iodide of potassium may be administered in considerable quantities *in succession* to dogs, without injuring them, while if they are given simultaneously, the animals are poisoned, apparently by the formation of iodate of potash. He observes that the two salts do not react in this way under ordinary circumstances, but they do so in strong acid solutions, or when in fusion, and when mixed and decomposed by the electric pile.

Medical Properties of the Teazle.—M. Beullard informs the French Academy that the leaves of the teazle, *Dipsacus sylvestris*, pounded, and applied to wounds and bruises, has a powerful action in the prevention and cure of gangrene. He removes mortified flesh, washes the wound in chlorurated water, and then applies a poultice of the leaves. He states that he used this remedy with success for fifteen years.

Bolide at Vichy.—M. Veriot describes a bolide, seen at Vichy on the 21st August (20th ?), at 7h. 20m. P.M., as like an enormous fusee, and brighter than the moon. It was visible for ten seconds, passing from N.W. to S.W. in a line making an angle of 20° or 25° with the horizon.

Shooting Stars near the Earth.—In *Astronomische Nachrichten*, No. 1606, is a communication from C. Behrmann, of Göttingen, stating, that on the 30th of July, about 9½h. P.M., shooting stars appeared to come out of a thick cloud, about 15° above the horizon, and vanished in about four-tenths of a second, having a visible path of five or six degrees. The cloud covered the entire sky, and was so thick, that a bright meteor could not have been seen through it; hence he concludes "that the shooting-stars were manifestly driven on this side of the cloud." He thinks these stars must have come within 0.1 mile of the earth.

New Freshwater Polyzoa.—Mr. C. Parfitt describes, in *Annals Nat. Hist.*, two new freshwater polyzoa he found in Devonshire, *Plumatella lineata* and *Limnas*. The first is characterized by eight or ten dark brown longitudinal lines running the whole length of the tubes. The polyp cells are barrel-shaped, and hyaline, the mouth entire, each having five or six dark brown annulations, slightly constricted at each annulus. Tentacles sixty-two; statoblasts dark reddish brown, elliptical, with a broad yellow margin. It was found on the underside of water-lily leaves, in a pond in Mr. Veitch's old nursery, Topsham Road, Exeter. The other (*P. limnas*) belongs to that section of the genus which includes *P. emarginata*; "but the line of demarcation between the diaphanous portion of the tube in this species and the thick opaque walls of the inferior half, gives it even at first sight a very distinct and marked appearance. Another striking peculiarity is that the tubes grow mostly in pairs, and are very closely adherent to the matrix, except the polyp cell, which stands up conspicuously near the end of the tube." The lower half of the tubes are opaque, and coated with grains of reddish-brown matter. The opaque walls are white inside, and made up of pentagonal cells. Tentacula fifty to fifty-four; calyx festooned. "Statoblasts elliptical, yellow, with a narrow blackish ring dividing the cell from the narrow purple rim or annulus which surrounds it." The orifices are conical, not quite at the end of the tubes, and stand at right angles to the tubes, being raised by three or four folds or rings.

Silvered Object-Glasses for Sun-Viewing.—M. Foucault proposes that, for the special purpose of viewing the sun, large achromatic objectives should have their outer sides silvered by chemical precipitation. He finds that a silver film, such as that deposited on the silvered mirrors for telescopes, does not interfere with the definition of an object, like the sun, bright enough to be seen through it.

The Spontaneous Generation Controversy still occupies the French Academy. Recently, M. Al. Donné, who formerly took the opposing side, adduced experiments on the affirmative side. He punctured the shells of eggs with a red-hot wire, enveloped the eggs in cotton that had been heated, with a view to destroy germs, and then immersed them in hot ashes. In the course of three weeks or a month he found moulds growing on the organic matter of the egg. M. Pasteur pointed out that the precautions to exclude germs of small organisms were by no means sufficient, and hence the experiment must be rejected.

The Cholera Mist.—Should the blue mist described by Mr. Glaisher still appear in any part of the country, it is most desirable that the organic particles it may contain should be accurately examined by the aid of the microscope. Mr. Glaisher and other observers have detected some small bodies of a blue colour, the nature of which has not, we believe, been thoroughly investigated. Microscopists should endeavour to ascertain whether such particles exist in sufficient quantities to account for the colour, and whether they represent known forms of sporules.

An Apple Congress.—The French Pomological Congress began its eleventh session at Melun on the 14th September. Its object is to induce the rejection of all mediocre and bad sorts of apple-trees, and to promote the cultivation of the finer and more profitable kinds. It is expected that the export of French apples will be extended by these measures; and we have need, as Mr. Roach Smith has pointed out, of something of the sort in this country, where the supply of good apples is below the wants of the population.